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Telephone magazine

Fred B. De Land, John C. McMynn, Frederic Auten Combs Perrine, Carl E. Kammeyer

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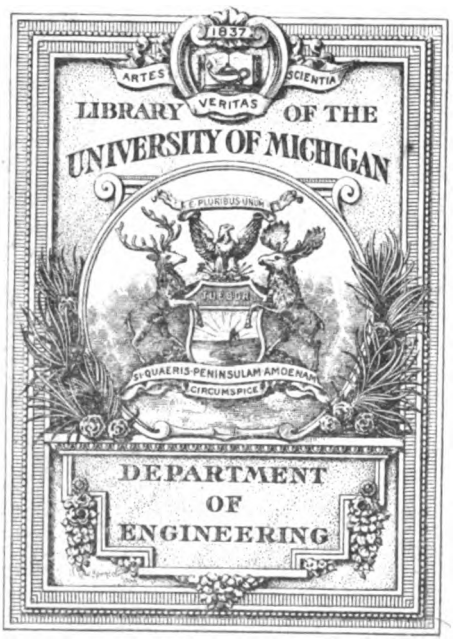

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Telephone Magazine

AN ILLUSTRATED MONTHLY MAGAZINE

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THE VERY IMPORTANT DECISION OF JUDGE BARNARD.

Nothing since the Berliner decision approaches in breadth and scope the decision of Judge Barnard in the court of last resort herewith given in full. The decision razes to the ground the Bell edifice built on the legality of their enormous public rates made to carry excessive maintenance charges. It shows that the New England Bell Company is handicapped by excessive carrying charges to the extent of $31 per 'phone.

This is perhaps the key-note of the successful independent competition.

JUDGE BARNARD'S DECISION.

"I am aware that in Manning *vs.* Chesapeake & Potomac Telephone Company (28 Wash. Law Rep., 97), the Supreme Court of the District of Columbia has held unconstitutional an act of Congress fixing maximum telephone charges in Washington at $50 a year, with one telephone on a wire, $40 with two telephones on a wire, $30 with three telephones on a wire, and $25 with four or more on the same wire (30 United States Statutes at Large, 537, 538, chap. 540, June 30, 1898), but a careful reading discloses sufficient evidence on the face of the opinion to invalidate the decision when the case comes before the court of last resort, the supreme court of public opinion. The ground of decision was that the rates fixed by Congress were unreasonably low, the evidence being the testimony and accounts of the Chesapeake & Potomac Telephone Company, doing business in Washington. In 1898 the company had a little over 2,000 telephones in use. It had been receiving $135 for a business 'phone and had averaged $100 income for every 'phone in use. It was estimated that the new law would reduce the average receipts to $47 per 'phone. The company was paying about $20 per 'phone in interest and dividends and $8.50 per 'phone to the Bell Telephone Company and the Western Electric for receivers and transmitters used by subscribers, drops on the switchboard in the central office and the use of patents the Bell Company may hereafter acquire. It claimed an average annual working expense of $71.20 per 'phone. The capitalization was $470 per 'phone ($100 bonds and $370 stock).

"Now let us look at these items in the light of other facts stated in the opinion. The actual value of the plant was found to be $441,436 as against $950,000 capitalization, or less than $220 real capital per 'phone instead of the $470 of existing stocks and bonds, making the fair capital charge not over $10 per 'phone, instead of $20. But further, a very large part of the $220 was due to the fact that the plant was not used anywhere near up to its capacity, and this in turn was probably due to the high rates maintained by the company. A large part of the capital outlay was for underground construction, putting in vitrified terra cotta ducts under asphalt pavements. The court said that 'the cost of additional ducts to provide for future growth of business is very trifling and it is in evidence that some three or four thousand subscribers could be served by cables to be drawn in the vacant ducts now maintained.' That is, the business could be doubled or trebled without more ducts and even further increase could be provided for at trifling expense. If the rates enacted by Congress had been put in operation, the subscription lists doubtless would have expanded

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greatly; and it is quite probable that the real capital per 'phone would have been speedily reduced to the neighborhood of $100, or $150 at most, in spite of the fact that Washington is a 'city of magnificent distances.' I know the judge doubted any substantial increase of subscribers thru lower rates, but the facts prove that the doubt was not well based. The following table presents a few of the facts bearing on the relation between rates and the use of the telephone:

"In Rochester, New York, a city of 162,000 people, or about three-fifths the size of Washington, there is an independent telephone company with rates of $36 and $48, on which eight per cent dividends are made on a large body of stock, all of which is water, as the bonds more than cover the value of the plant. With these rates, which are still too high, there is one subscriber in Rochester to each forty persons, showing that with anything approaching reasonable rates our people become large users of the telephone.

RELATION BETWEEN RATES AND USE.

	Relative size.	Rates.	No. of telephones.
Washington (1898)	1	$36 to $135 ($100 average)	1 'phone to 120 persons.
* Stockholm	1	20 average	1 " " 23 "
* Christiania	⅔	22 "	1 " " 30 "
* Trondhjem	½	13 "	1 " " 38 "
* Berne	⅓	10 upward	1 " " 40 "
* Zurich	½	10 "	1 " " 50 "
* Berlin	7	36	1 " " 60 "
Copenhagen	1½	41	1 " " 70 "
Amsterdam	2	50 to 100	1 " " 150 "
* Paris	10	78	1 " " 170 "
Greater London	22	100	1 " " 700 "
Greater Boston	4	25 to 150	1 " " 60 "
Greater New York	13	90 to 240	1 " " 120 "
Chicago	6	60 to 175	1 " " 130 "
Philadelphia	5	60 to 250	1 " " 170 "

* The cities starred have public systems, the others have private plants. The American figures relate to 1897 and 1898, the year of the Washington discussion. The European figures are a little earlier and therefore probably less favorable to them, as the use of the telephone grows each year. In the column of size Washington has been taken as the unit and the other cities classed according to their relative size as compared with Washington—Zurich half the size of Washington, Copenhagen one and a third times as large as Washington, Philadelphia five times as large, etc.

"The evidence is that low charges, whether in cities larger or smaller or the same size as Washington, induce far larger use of the telephone than exists in Washington, such larger use being found as an accompaniment of low prices in cities of vastly less general intelligence and prosperity than Washington, and in cities having private plants as well as those having public systems; whereas in foreign cities like Amsterdam, Paris and London, having high charges (tho only one as high as Washington), show a lower use of the telephone than Washington, and the same is true of American Bell cities excepting Boston, which, being the hub not only of the universe, but of the telephone business, and a city of great prosperity and unsurpassed intelligence, naturally breaks the record.

REDUCTION WOULD INCREASE BUSINESS.

"Upon the facts here stated and the whole body of existing telephone data there is the strongest reason to believe that lowering the rates to the congressional level of $25 to $50 would very largely increase the number of subscribers, probably doubling the use of the telephone and perhaps trebling it within two or three years. The judge said that the court must take care not to intrench upon the authority of the law-making power, not to disregard the statute under consideration, unless 'it be unmistakably repugnant to the fundamental law.' Yet the court refused to consider the case on the basis of the probable increase of business and decided it upon

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facts relating to the preceding years under higher rates. Suppose the law in Hungary establishing the zone system, reducing rates forty to eighty per cent, had applied to a private system of railways instead of a public system, and the railroads had brought the matter into court, claiming that the law confiscated their property, saying that since they had only been making ordinary interest on their capital at the old rates they would surely make a loss on the new tariff averaging less than half the old one. The companies would have made out their case on the basis of existing rates and business, and the law would have been declared unconstitutional on the principle of this Washington decision, and yet the law was so far from unmistakably repugnant to the fundamental law against confiscation that the actual result of putting the law in operation was an increase of net earnings instead of a loss, as had been expected. It is not possible to foresee the effect of such a lowering of rates either in the railroad or the telephone field, wherefore the court can not know that such a law as that relating to the Washington telephone is 'unmistakably' repugnant to the Constitution. The true plan in such a case is to enforce the law for a reasonable time until it becomes clear that the effect of the law is to deprive the company of a reasonable return — clear as a matter of fact and not as a matter of supposition or inference from more or less irrelevant data. Then the law may rightly be declared unconstitutional, and the company should have the right to collect from the Government whatever damages have been inflicted upon it by the said enforcement; but if upon fair and honest trial the law justifies itself it should be declared in force.

"In the Wellman case (143 United States, 339) the Supreme Court of the United States clearly recognized the principle that the increase of business from lowered rates must be taken into account, and made this principle one ground for refusing to hold void a railway law of Michigan fixing maximum passenger rates at 2 cents a mile. In Indiana a statute fixing the rent of a telephone at not over $3 a month, or $36 a year, has been held valid, altho the company in suit was charging $11.16 a month, or $134 a year, and claimed it was only making reasonable profits and could not manage on $36 a year.

"To return to the Washington items. It is probable that the enforcement of the congressional rates would double or treble the business, and bring the real capital per 'phone down to $100 or near it, thereby reducing capital charges from $20 to $5 or $6 per 'phone.

"The $8.50 monopoly tribute to the Bell and Western Electric is almost wholly an unjustifiable charge under an agreement made years ago, under pressure of the fact that the Washington company, like those in most other American cities, are really subsidiary Bell interests, or branches of one big monopoly.

AN ABSURD CLAIM.

"The claim of $71 per 'phone for working expenses is absurd in my judgment. Compare it with the working expenses of $6.43 reported in this same city of Washington for the telephones of the widely scattered buildings connected with the Interior Department's exchange above mentioned, and the difference makes the $71 claim incredible. Remember that this same private telephone interest which now claims it can not reduce rates because its $100 of average receipts is only just enough to cover cost of working and capital charges, made a similar claim when the Department of the Interior asked for reduction six years ago, and yet when the Government put in its own 'phones the service cost only $10.25 for maintenance, operating cost, depreciation and interest, in place of the $75 per 'phone formerly paid. The claim of the company in 1894 that it could not reduce its charges of $60 to $125 for these 'phones has been conclusively proved erroneous, and there can be no doubt in the mind of any one familiar with telephone data that its present claim is also erroneous. In Grand Rapids, as I have said, the Bell interest was charging $36 to $48, and claimed it could not reduce rates, and yet the people are now ac-

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tually obtaining equally good service for $3 a year residence, and $18 for a business place, and a small surplus is realized even at these rates. Bell estimates are clearly unreliable. Considering the length of time the Bell companies have been in operation, they seem to know remarkably little about the business when it comes to reducing rates.

"With the fine underground system established in Washington, repairs and maintenance should cost comparatively little, and the operating expenses are not very heavy — all lines go to the central station, where one operator manages one hundred lines, and the public stations in hotels, etc., are managed on the slot machine plan instead of having paid attendants, as in Boston and many other cities. The $71 I believe to be more than double the fair figure for working expenses. Companies have many ways of adjusting their accounts so as to show large expenses and small profits. It is a common thing to charge the cost of extensions and repairs to maintenance and operation. Sometimes quite ethereal expenses are put down in the material column. For example, last year in examining the accounts of the Boston gas companies, an item of $15,000 for gas mains was found to cover such expenses as '$1,200 to Mr. L.,' '$1,500 to Mr. M.,' etc., L. and M. being gas lobbyists at the State House. This year it stated on the authority of one of the directors of another gas company that $1,000,000 is charged on the books of that company to an account that did not receive a dollar of the money, which was abstracted and used for illegitimate purposes. Corporation accounts are very unreliable affairs. And this Chesapeake & Potomac Company has had, without any unlawful abstraction of money, special opportunities of erroneously accounting. As to the capitalization and expenses in Washington — these special facilities arise from the fact that Washington is only part of the territory occupied by the company — the stock for its whole territory being $2,650,000, and for Washington alone $750,000. A small percentage of error in apportioning expenditures as between Washington and the outside territory of the company make a considerable difference in the Washington results.

A JUDICIAL BLOCKADE.

"I believe the Manning decision was a judicial blockade of a just law — there was no reliable evidence that the congressional rates were too low, while, as the court admitted, there was evidence 'that in many cities in this country and also in Europe, telephone service is supplied by the Government or by corporations at rates which appear to be less than those fixed by this act,' and there is a vast amount of evidence not referred to in the case, which tends to show the unreliability of the company's claims and the fairness of the law. Nevertheless, in view of the well-known power of giant corporations to tangle a court with ex parte statistics, and claim protection against possible loss, it seems to me that it would be wise to provide in such acts that the law shall be enforced for a year or two under a guarantee that the Government would make good any deficit resulting from the legislative rates causing the income to fall below working expenses and fair capital charges, providing such deficit occurs in spite of reasonable efforts to make the new rates successful, and is ascertained upon accounts carefully watched day by day by a public officer, with full powers of inspection, both of the accounts and the manner of conducting the business. In some way the public must take the risk of such changes for the benefit of the public, or else the courts will stand between the corporations and the law. For while the judges say that the law must be unmistakably contrary to the Constitution to be void, they frequently act on the principle that it will be void if the companies can make it appear doubtful whether the new rates will yield a profit. Thru some such modification as I have just suggested, or by frequent small reductions, the regulative power may make itself felt — but the only clear, clean, certain and complete solution is public ownership.

PATHETIC AND HUMOROUS.

"After making this statement regarding the Manning case, I submitted to

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President Holbrook, of the Massachusetts Telephone Company, the question of the credibility of the $71 charge for working expenses under Washington conditions. His reply was that the said claim was not only absurd, but pathetic, and not only pathetic, but humorous — pathetic that a claim nearly three times the reasonable figures should be made, and humorous that men in authority could be made to believe such a claim. With underground wires in a plant like that of Washington the fair charge for maintenance and operation would be about $25, according to President Holbrook. In Montreal, a city about the same size as Washington, with wires largely underground, a good profit is made on a $50 telephone rate established by the Dominion Government. In Rochester, a city of 162,000 people, the independent telephone company has 3,600 subscribers, and the Bell has dropped to 400. The cost of the independent company's line has been a good deal less than $10 a line. The plant is bonded for $400,000, and the stock is $400,000, a capitalization nearly three times the real value of the plant, yet the company pays eight per cent dividends, with rates of $36 and $48 per telephone year. Referring to the New England Telephone Company, President Holbrook says the cost of operating they maintain is $11 a 'phone; the cost of maintenance, $24 a 'phone. Their general expenses, including taxes, is about $11 a 'phone. Now these figures are excessive. There is an overcharge on maintenance of $13.50 per 'phone, which is due to the necessity of their building old-fashioned and worn-out plants entirely over. They are obliged to pay $4 a year royalty on each 'phone, $2 extra on taxes per 'phone, owing to the fact that they are stocked and bonded at $30 a 'phone; whereas $100 would rebuild, and in an entirely modern way, their entire system. A capital charge of $12 in excess is therefore put against each 'phone. In other words (taking all the facts into account), the New England Company is handicapped to the extent of about $31 a 'phone. As the New England Company average $58 per 'phone, this opinion of President Holbrook would indicate $26.50 as the normal average charge for that company's exchanges, which more than confirms my own estimates stated above."

GOVERNMENT OWNS TELEPHONE SYSTEM IN PORTO RICO.

Uncle Sam is in possession of a telephone system in Porto Rico which came to him as a legacy from the Spanish Government. General Greely, the chief signal officer, who superintended the reconstruction of these lines, favors a continuance of the policy pursued by the Spanish Government. If his plan is adopted the United States will not only own a valuable telegraph plant, but a telephone system which will cover almost the entire island.

Under the Spanish system concessions for telephone lines were granted to the highest bidder at a public auction, the bidding being on the percentage the Government received from the total collection, the minimum of which was six per cent of the collections. Concessions are granted for a period of twenty years, counted from the date of the drafting of the instrument containing the contract. Upon the expiration of the period of concession the telephone lines and apparatus become the property of the Government, which is not required to pay the concessioners anything for it.

The concessioners are required to install the most perfect apparatus known at the time the service is inaugurated. If there are any inventions which, in the judgment of the Government, may be of benefit to the telephone service, the concessioner is required to make use of it within the period of six months, and should he not do so the Government is authorized to establish a new service, making use of the improvements which the new invention might furnish.

In addition to this, the Spanish Government fixed the rates charged for telephones, the maximum charge being $102 for each station.

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THE LOSS OF A MILLION.

On December 1, 1898, Valdemar Poulsen, of Copenhagen, Denmark, secured a patent in Denmark for a recording telephone or telegraphone. A patent in Germany was also secured, which is reported to have been sold for $250,000. The United States patent was applied for on July 8, 1899, and granted on November 13, 1900. On May 4, 1901, the Patent Office discovered that this United States patent bore on the face of it the evidence of its invalidity. There is in force in this country a patent law which requires application for United States patents to be made within seven months of the granting of any European patent. From December 1, 1898, to July 8, 1899, is seven months and seven days, and as the United States patent was applied for at the latter date it will be seen that the application was seven days outside of the limit set by law. Hence, it would seem that the United States patent is not worth the paper that it is written on, and any one on this side of the water can manufacture Poulsen's recording telephone without fear of suit. It is alleged that the discovery was made when the patent was being investigated by the attorneys of some capitalists, who desired to purchase the American rights of what is considered to be a very valuable invention. It is also alleged that the terms of purchase were arranged and that the figure was $1,000,000, which was to be paid to Mr. Poulsen for his discovery. Of course, on the discovery by the Patent Office of the invalidity of their patent granted on November 13, 1900, Mr. Poulsen found himself without anything to sell, and the capitalists who wished to take up the manufacture of this invention can do so without a purchase and with only the fear of a competing company or companies to deter them.

Mr. Poulsen's patent attorney in New York is Mr. William A. Rosenbaum. As soon as information of this matter reached us we wrote Mr. Rosenbaum that we intended to publish an account of the matter as it had reached us, and offering him the chance of appearing in our columns in a letter describing his side of the case. Later we had the pleasure of an interview with Mr. Rosenbaum, who claims that the blame of the matter rests entirely on Mr. Poulsen's foreign representatives, whose fault it was that the papers in the case were not forwarded to him in time.

Further advices from Mr. Rosenbaum assure us that a complete and satisfactory explanation of the entire matter, both from the foreign representatives and from Mr. Rosenbaum himself, will be forthcoming in time for our issue of June 15, which explanation will be published just as it comes to us. It is not our intention to do Mr. Rosenbaum or his representatives the least injustice. The matter is extremely serious for Mr. Poulsen, seeming to involve, as it does, the loss of a large amount of money, and while it seems strange to us that the matter received so little attention that so valuable a patent was lost to the inventor, we are not able at this time to pronounce definitely a judgment in the matter and must content ourselves with telling the story as it comes to us. We, however, emphasize the above-mentioned notice that further accounts from Mr. Rosenbaum himself will be forthcoming in a later issue.

We have told this story as it has come to us. We have not, however, told all the story. Further developments have reached us, which, if true, will make this matter the most sensational in patent circles since the recent Bell telephone litigation. We are waiting for undeniable confirmation of the evidence now in our hands and can promise some sensational matter in the near future.—*American Inventor.*

CENTRAL CITY, NEB., March 1, 1901.

Electrical Engineering Publishing Company, Chicago, Ill.:

GENTLEMEN,—I have not yet received my February issue of THE TELEPHONE MAGAZINE. I wrote you to send it here instead of Thurman, Iowa, but have not seen it. Please send it, for I do not want to miss a single number — can't keep house without it.

Yours respectfully,

C. L. PICKETT.

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THE REPORT OF THE CONVENTION.

The Independent Telephone Association of America held its fifth annual convention at Buffalo, New York, June 11, 12 and 13. In point of numbers it was the largest telephone convention ever held. The association was called to order by Judge J. M. Thomas, president, at Convention Hall, at noon of June 11, by the introduction of Hon. Conrad Diehl, mayor of Buffalo, who made the following brief address:

MR. PRESIDENT AND GENTLEMEN OF THE CONVENTION,— On behalf of the city of Buffalo I extend to you a most hearty welcome. I appreciate the business that brings you to our city, and feel the importance of it. I feel that competition is, as the old saying is, the life of trade, but in your case I think it goes further. I think competition in telephone service is an important matter, and is unquestionably a benefit and help to the person using the telephone. I know that the results from telephoning, the question of an answer, the delay in an answer, the vibration of the machine while getting an answer, and all the different intricate studies that belong to the telephone, which your meeting will certainly look after, will bring betterment not alone in the price, but also betterment of service, and if you succeed in that you will certainly be doing a benefit to mankind, as the telephone is almost as necessary an article as food which we live on at the present day. Now, gentlemen, in our city, as you are in our city, I will hope that, after doing your business, you will take a little advantage, not alone of rest and pleasure looking at our exposition, and right while I am at the exposition I think you will find a great deal there pertaining to your meeting, especially as we have everything there in the way of electricity. Further than that I hope that our local committee will see that you get the advantage of our beautiful drives and see that you get to our commercial centers and see what electricity really does in our large elevators, mills, factories and printing-houses, which are today running by electricity supplied by nature itself—the power of Niagara.

To do this I want you to feel perfectly at home. I want you to go about our city, and look at our commerce, our factories and our pleasures, and feel perfectly at home. I want you to accept the freedom of the city in the fullest sense of the word.

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ANNUAL ADDRESS BY THE PRESIDENT OF THE ASSOCIATION, HON. JAMES M. THOMAS.

All will agree that the committee entrusted with the selection of the place for the fifth annual convention of the Independent Telephone Association of the United States of America used commendable judgment in choosing the beautiful city of Buffalo, as, with its natural advantages and its great Pan-American Exposition, no other city in the United States could have offered a more desirable place for the convention.

Representing, as this organization does, progress in telephony, it is befitting that we meet in Buffalo, where we may study the progress made by the great American countries in art, science and their many and widely diversified industries. We are not only afforded another opportunity of considering further development of our own business, but, between sessions and after this convention adjourns, will be entertained and enlightened by a study of results in all the various fields of private and public progress.

While we are busy with the affairs of this convention and the pleasures which have been arranged for us, we should not forget to thank the local committee of arrangements for its labor.

The past year has been one fraught with important events in the telephone world, and the great work that has been accomplished is the highest commendation that can be offered to the great army of workers in the field. Having been in close touch with all the great independent organizations of the country and knowing their present status, I do not hesitate to say that all doubt of the permanancy of the independent telephone movement has passed. Doubters have become its advocates, while the voice of the false prophet is no longer heard in the land and his writings have been placed in the archives of oblivion, bearing the inscription above its portals, "Failure."

The work in the middle West, North and South, the greatest fields of activity in telephone development, is to be followed by very active development in the extreme eastern and western sections of the United States, and in a short time the organizations now nearing perfection in those sections will show a development that will be highly gratifying to those of us who for several years have labored in the fields now more fully developed.

In speaking of the convention held by this organization, I have heard several gentlemen who have attended them say that the general tone resembles more political conventions than conventions of allied business interests. I have always agreed with that statement with a limitation that they have been somewhat like political conventions would be with the politics eliminated. Like public conventions, we have never lost sight of the principles of progress and fair dealing with the people and, being so different from the meetings of the men who control the Bell companies, this impression has found lodgment in some minds. But this spirit, being the surest sign of the fundamental principles of progress, we desire that it shall always be the key-note of all conventions of the organization.

There has been much inquiry, not only on the part of those who have control of this field of investment, but also by those desiring to enter, as to the underlying principles that actuate the development of this movement. To fully and properly answer that inquiry requires a careful study of the entire history of telephony and would require more time than those of us who are actually engaged in construction and operation have been able to give to the subject; but a glance over certain events and certain policies will be of interest and profit to persons seeking the knowledge desired by the prudent man before investing in the building of telephone properties.

The telephone being one of the greatest utilities discovered and put into practical use by man, and being entirely new, and the only means of reproducing articulate speech at a distant point, gave the inventors a right to protection for seventeen years under the United States statutes, which rights the inventors could keep or sell to others if they so desired.

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Bell's invention, the first put into practical use, and which at one time was a useful and satisfactory transmitter, being what we generally term a magneto telephone, gave place to a more effective instrument, the product of the minds of several inventors, but brought into perfection by that great inventor, Thomas A. Edison, who discovered the fact that carbon electrodes held in constant contact, but so arranged as to admit of variable pressure in conformity with sound waves, the result of articulate speech, thus regulating the flow of an electric current thru them produced by a battery in connection therewith, gave a fuller and more perfect transmitter than Bell's invention.

After this discovery Bell's invention was fast supplanted as a transmitter by the more effective microphone, but its use as a receiver in connection with the microphone has been universal. For the purposes of this investigation the great volumes of records and briefs in litigation between inventors, or their assigns, will be of very little service, and, therefore, we pass to such facts as will enable us to more fully understand the history leading up to the beginning of the independent telephone movement.

The first, or fundamental Bell patent, expired in March, 1893, and the second Bell, or magneto telephone patent, expired in January, 1894; and between these dates we find the work of establishing independent systems began. November 17, 1891, the Berliner patent was issued on an application filed June 4, 1877. The claims of this patent were intended to be broad enough to cover all constant-contact battery transmitters, and these were believed to be all battery transmitters of commercial value.

In May, 1893, the Edison carbon transmitter patent was issued on an application also filed in the year 1877; and it should be remembered that both the Berliner and Edison patents were owned by the American Bell Telephone Company. This patent was for the use of carbon electrodes in a battery transmitter. No other material has been found as a practical substitute for carbon.

These two patents were for seventeen years from the date of their issue; and if either or both of them had been found valid, it would have continued the Bell telephone monopoly to the year 1908 or 1910.

When the Berliner patent was issued, Milo G. Kellogg obtained a certified copy of the record of the application in the Patent Office, and after a careful study of the same for several months, became convinced that the patent was invalid for several reasons and would not be sustained by the courts, if intelligently litigated. He also realized that unless its validity was attacked in some unusual manner, it would remain as a menace to prevent any extensive competing use of battery transmitters, and when it came to be litigated, if such a case should arise, the defense was likely to be weak and ineffective, and the patent therefore, likely to be sustained, and thus the Bell monopoly would continue to the end of the term of the patent. He then conceived the idea that the question was one of great public importance, and that the patent, having, as he believed, been improperly granted, the Government itself should begin a suit to test its validity, on the basis of annulling or revoking it. It was then certain that a patent could be revoked on the ground of fraud, but it had not been adjudicated whether a patent could be revoked on the ground of invalidity. The proper channel for bringing suit to annul or revoke a patent was thru the attorney-general in the name of the United States against the party or his assigns claiming the right of monopoly under the patent.

He prepared a brief of about one hundred and fifty pages, giving the various grounds on which he believed the patent was invalid, and in November, 1892, presented the same to the Attorney-General. After the matter had been considered, and with the approval of President Harrison, a bill was filed by the Attorney-General in 1893 in the name of the United States against the American Bell Telephone Company. The first decision in the case was by Judge Carpenter, who declared the patent invalid for two reasons, but did

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not pass on the other grounds of invalidity which were raised. These two reasons were, first, fraud in obtaining the patent, and second, the fact that a patent had been granted to Berliner on the same invention in the year 1880. The case was carried to the United States Circuit Court of Appeals, which held that the only ground on which the patent could be canceled or annulled was that of fraud, and that the other claims of the bill could only be set up as defense in a suit brought by the owner against an infringer. This court found that no fraud had been proved, and that, therefore, the patent could not be ordered canceled. The Supreme Court on appeal took the same view of the case.

After the decision of Judge Carpenter in the Circuit Court, the few companies which had begun to manufacture and build exchanges took new courage and many others entered the field, and this new impetus assured our present great success in spite of all that has been done to discourage us.

After the decision of the Supreme Court in the Government case, the testimony was completed in the infringement cases which the American Bell Telephone Company had in the meantime (August 5, 1895) brought against the National Telephone Manufacturing Company and the Century Telephone Company. The defenses in these cases included the same ground of invalidity set up in the Government case except that of fraud, and the decision of Judge Brown, recently handed down, practically sustains all the defenses except one.

The Edison patent on the use of carbon in the transmitter was no doubt valid; but the question arose concerning it as to the effect on its life of Section 4887 of the Revised Statutes. The application for this patent was filed before Edison had taken out any foreign patents on the invention, but the patent itself was issued after he had taken out foreign patents, and in fact after such foreign patents had already expired. With one interpretation of the meaning of Section 4887, the foreign patent would limit the life of the United States patent, and the patent had already expired at the time of its issue. The interpretation of this section had already been raised in regard to other patents, but had never been passed upon by the Supreme Court, and it was uncertain what the decision there would be. There was pending before that court a suit known as the Bate Refrigerator Company *vs.* Ferdinand Sulzberger, et al., in which this particular question was involved. The case was one of minor importance, but on the outcome of the same depended the question as to whether the Edison carbon patent, owned by the Bell Company, and some important electric light patents owned by the General Electric Company, should extend for seventeen years or had already expired. When this comparatively unimportant Bate refrigerator case came to a hearing before the Supreme Court, the side which was favorable to the Bell Company's contention was most ably and elaborately presented, Mr. Storrow, chief counsel for the American Bell Telephone Company, and other noted lawyers presenting very able briefs on the subject. The other side was also well represented, especially by Mr. Wetmore, of New York. There was, however, nothing to show that there was practically anything more at stake than the contest between the Bates Refrigerator Company and Sulzberger. At the hearing, however, a request was made and granted that Hon. Charles H. Aldrich, formerly Solicitor-General, be permitted to file a brief in the case on behalf of Milo C. Kellogg as "one whose interests as an inventor of telephone appliances, and as a stockholder in companies operating telephone exchanges and manufacturing electric light and other apparatus, would, in his opinion, be disastrously affected by an interpretation favorable to complainant of Section 4887 Revised Statutes." Mr. Aldrich's brief thus filed pointed out to the court the great interest involved in the suit, and the legal grounds for an interpretation of the section which would, in fact, limit and make the Edison patents ineffective. The Supreme Court decided the case in favor of defendant, holding that under

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Section 4887 United States Revised Statutes, the expiration of a foreign patent limited the grant under our laws to that time; and, as far as the statutes then stood, the Edison carbon patent became a dead issue.

However, while this Bate case was pending before the Supreme Court, several bills to amend Section 4887 were introduced in Congress, the effect of which, if passed, would be to give life to the Edison patent for seventeen years from date of its issue. The real animus and source of the instigation of these bills was not apparent. The fact of their existence and the real motive and effect of the same came to Mr. Aldrich's knowledge, and he prepared a memorial to Congress on the subject entitled "The American Bell Telephone Monopoly and the pending legislation in its interests." A copy of this memorial was sent to every member of Congress. The effect of the same was that the real motive for the proposed legislation was exposed and thus the bills were defeated.

But to show how adroitly the affairs of the American Bell Telephone Company were managed we must now consider a few facts which were the result of the thought of great minds employed to prolong the monopoly. Edison having applied for foreign patents, and they, recognizing the danger of limiting his rights under Section 4887 Revised Statutes should their efforts fail to repeal or annul it, the Berliner application for a patent was, by shrewd manipulation, kept pending in the Patent Office for fourteen years, and he, so far as we have discovered, made no application in a foreign country under the statutes of which the patent in this country would be limited, but only in such countries the laws of which would not bring it under our court's interpretation of Section 4887, in view of the danger growing out of the Edison foreign patents. After the Berliner caveat and application had passed to the ownership of the American Bell Telephone Company, which did not claim a constant-contact telephone which would reproduce speech, but a make-and-break transmitter which would reproduce musical sounds, this able corps of experts in the pay of that company managed, after this delay of fourteen years, to obtain a patent by amendment, claiming just the invention that Mr. Berliner had disclaimed in his caveat and original application.

After the decision in the United States Supreme Court in the Government case, thru the efforts of J. D. Leatherbee, treasurer of the National Telephone Manufacturing Company, Edward P. Payson, of Boston, a very able and conscientious lawyer, proceeded with the arduous task of completing the proofs to sustain the defenses set up in his answer to the bill of complaint in the case of the American Bell Telephone Company against the National Telephone Manufacturing Company. Mr. Payson gave to this case a great portion of his time and his best thought from the time of his retainer in 1895 to the time the case was finally submitted to the court, November, 1899.

Judge R. S. Taylor, having been selected by the Government as one of the counsel in its suit, and being very familiar with the questions involved, was retained to file a brief and make an oral argument in the case against the National Telephone Manufacturing Company on behalf of the defense.

February 27 last Judge Brown, of the United States Circuit Court, District of Massachusetts, handed down his decision after considering the case from November, 1899, to that time; and from his rescript, indicating his deep study of the questions involved in that important case, the impartial words of the learned judge clearly indicate his conviction as to the deep-laid scheme to prolong a monopoly.

We certainly should appreciate the efforts of these men who have so ably resisted the efforts of the representatives of the American Bell Telephone Company to retain that which by law had passed to the people; and no voice should be heard except in the highest commendation of their work. Their intelligent and arduous labors have defeated the skill and cunning of those who were employed to try to deceive

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our patent officials and our courts. I feel at this time it is not only the duty but the pleasure of this organization to make public acknowledgment of their services.

This combined effort has resulted in the decision of Judge Brown in which he holds:

First — "That at the date of the application, June 4, 1877, Berliner had not made the invention covered by the patent issued to the American Bell Telephone Company on November 17, 1891."

Second — "That the invention designated in the patent is radically different from the invention described in the application."

Third — "That the invention was previously patented by Berliner."

Fourth — "That Edison was the prior inventor."

Judge Brown agrees with the well-known position of all telephone inventors that Berliner, so far as his claim to a microphone is concerned, invented nothing.

These facts, together with the policy of the Bell companies in dealing with the people, have been the chief incentive to invest in this field. The people were anxious for relief from their arbitrary methods and have always welcomed an independent company.

Having proven our legal rights to give telephone service by good and efficient methods, and having demonstrated our ability to compete with the old companies, it now becomes a question of working together for one common end; and it is important that at this meeting we consider such questions as will lead us to unity of action. The present year will add much to our present strength by placing a large amount of money at our disposal.

In closing I wish you all a profitable year, and thank you for your many courtesies.

VILLAGE EXCHANGES AND FARMERS' LINES.

BY HON. S. P. SHEERIN.

MR. PRESIDENT AND GENTLEMEN,— One of the many good fortunes of the farmer is to have constantly at hand some man (or men) from any or all the other vocations of life ready and willing to tell him what he ought to do. I regret to say, however, that notwithstanding the very excellent opportunities afforded him to follow the advice of other people, the farmer still persists in having a will and a way of his own.

With all due respect to our farmer friends (and in my high regard for them I allow no man to go before me), I do not believe that they yet appreciate the great blessing the telephone has brought them. The telephone — which, after all, has only had its development in the last six or seven years — is a greater boon to farmers than to any other class of people. The great drawbacks of country life are its isolation, its meager opportunities for social intercourse and its still fewer opportunities for protection. When we add to these the disadvantages of being out of touch with the market and out of reach of the great news pulse of the country, the sum of the country life's shortcomings is complete.

The telephone changes all this. It comes as a benefactor — exceeding all others in its possibilities and usefulness. No man can fully estimate its benefit to the farmer. It brings his ear close to the market tickers of the world; brings the weather report to his door in time to protect his crop and cattle; and travels what would be to him and his horses weary miles, in the ordinary transaction of his everyday business. The telephone should be welcomed by the farmer, with open heart and ready hand, to the best of everything he has. I regret to say that this is not always done. Our farmer friends still insist, in a great many localities, upon being somewhat beggarly in their treatment of the telephone.

The telephone can not, any more than any other agency, perform its proper functions except under fairly good conditions. It is entitled to the very best we can give. It is no longer an experiment; it has demonstrated its usefulness and its right to a fore-front position in the economics of life, as completely as have the locomotive, the steamboat, the reaper and the threshing

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machine. It was extremely unfortunate in its birth, and its boyhood associations were not good; but it is fast approaching a glorious American manhood — "redeemed, regenerated and disenthralled."

Men do not now hesitate to put sufficient money into railroads; the steamboats on our lakes and rivers are perfect floating palaces; and the wise farmer pays a good price and gets a good article of reaper and threshing machine, when he has reaping and threshing to do. It is, I am afraid, a slight reflection on the usual good sense of the average farmer, who has progressed, in other respects, out of the cheap way of doing things, to find him insisting upon putting up cheap, grounded telephone wires, on native poles three and four hundred feet apart, marring the landscape and furnishing temptations to profanity by those who have to use them. A poorly constructed and badly managed country telephone line is many hundred times worse than no telephone at all. There was a time when these things served their purpose, as educators, but that time has passed.

The large-letter primer, while a very excellent thing in its time and place, is not to be considered as a means of education by the chap who has reached the fifth reader, and is already fishing his jaw-breakers out of the Century dictionary. We live in a progressive country. It is our duty to progress with our neighbors. We have no business to be clogs upon the wheels of progress. It is the duty of every fair-minded citizen to undertake to discharge — faithfully and well — his fair share of the obligations of citizenship. The farmer who fails to do this falls short of doing his full duty. The country telephone is fast becoming the most important feature of rural life. It should be treated with the respect and liberality which is its natural due.

The country telephone line, and all other telephone lines which go along the country road, should be considered as part and parcel of the road itself. They should not, in my judgment, be considered as tenants of the road or as something that is there by sufferance, or by the permission — grudgingly given — of those who, for the time, do not appreciate its advantages; but it should be regarded as a part of the road itself. One of the primary functions of roads was that of facilitating messages between civilized peoples. The savages of the forests used their foot and bridle paths to transmit messages of peace or war, love or hate. Civilization early found its use for the messenger, and so well were his rights established that, I believe, it was laid down in the early common law, that the pedestrian bearing a message along the public highway had rights superior to the horseman.

The telephone is a messenger; more than that — it is a troop of messengers. It carries, from home to home, from heart to heart, the messages of the people. It should be as highly regarded and as free from interruption on the highways of the country as the bearer of a writ of habeas corpus. There is no other means by which messages can be transmitted with so little wear and tear to the roadway. I look forward to the time when telephone lines will be regarded as such sacred property that men and boys will no more think of interfering with a country telephone line than they do now of throwing stones at windows or killing song birds as they pass along. In order, however, to be entitled to this high regard of the public, the telephone must, by its outward appearance, command the respect of the people. We are apt to say, sometimes, that "clothes do not make the man." I think this is true; but we can not deny that outward appearances go a great way toward giving good or bad impressions of people and things.

Telephone lines should be substantially and neatly constructed. They should be of the very best material — good, heavy, well-shaped poles (no pole shorter than 25 feet, nor smaller than 6 inches in diameter at the top); cross-arms should be of regular length, and the wire put on in a thoroly mechanical manner. I have an impression that, as time goes on, and our high regard for the telephone increases, we may get

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along with shorter poles, and put our wires as near to the ground as electrical conditions will permit. My thought is that we will not have to use very high poles anywhere, except at road crossings, and it is barely possible that we may reach a condition where it will be found easier to go under cross-roads than over them.

Wherever it is possible, I think that not more than one line of poles should occupy the same side of the road. It will be entirely possible to build a line, sufficiently strong and symmetrical, to take on all the lines that should go along any particular roadway. Of course, it goes without saying, that all lines should be iron or copper metallic, and, as nearly as possible, the maintenance of the whole line should be under the control of one head, without reference to how many people or companies may be interested in the pole line.

One of the great troubles of the country telephone line — as, indeed, it is one of the drawbacks we all have in cities — is the trees. In the cities we are able to escape this annoyance very largely by the use of cable; but, of course, it would be impossible to do this in the country. Not taking into account the great additional cost of that sort of construction, there are electrical considerations that make a continuously long cable line an impossibility. The trees on the country roads should give way to the telephone. I am an advocate of trees, and believe that we should cultivate our forestry, in every possible way consistent with the discharge of our other obligations. But as it was necessary to trim away the original forests to make the roads, so would I trim away the trees along the side of the roads which interfere with that part of the road which belongs to the telephone. Trees along highways, near residences, can just as well be set back twenty-five or thirty feet. They have no business on the highway, or overlapping the highway, when they interfere with the uses of the highway.

The telephone is a proper use of the highway. In many respects it is the most important use. Being a comparatively new thing, it may take legislatures and courts a little while to appreciate all this, but just as surely as our American legislation and jurisprudence has found a way to clear all the other obstacles from the path of material progress, so they will find a way to order the trees along the highways set back out of the way of the telephone. They will do this because the people will demand it — and the people here always get what they want.

Now, as to village exchanges; I believe they ought to be made just as numerous as the wants of the people may require — in fact, I think that a great number of small exchanges is infinitely preferable to a number of long, heavily laden, party lines. There is not only utility in this, but a great deal of economy as well. The larger the number of people to be reached, and the quicker we can reach those whom we desire to communicate with, the better our service will be. In my judgment, village exchanges should be encouraged everywhere, and these village exchanges should have direct communication with the county-seat exchanges and the exchanges in other towns of the county; and these exchanges, in turn, should be connected with the long-distance lines of the several States. Our combination of lines and exchanges should be so complete, that the farmer, sitting at his own hearthstone, can communicate, by telephone, with any one, no matter where located, to whom he desires to speak.

The equipment of these country exchanges should be, in all respects, first-class. I regret that this is not always so. It is often very poor, and I come now to show some of the causes for this. With all due respect to the manufacturers — and I think the manufacturers are entitled to a great deal of credit for the development of the telephone business — I can not help the feeling that they are very largely responsible for a great lot of shoddy, inefficient, and wholly abominable telephone equipment in the country. They go upon the theory that the farmer wants something cheap, and that the way to catch him is to present a very low-priced article, without very much

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reference to how long it will last or what service it may give him in the meantime. This is little short of criminal, and can not be too strongly condemned. This association, and all other people largely interested in the telephone business, who want to escape responsibility for bad service by other people, as well as by themselves, should set their faces firmly against the manufacturers who make, specially, "cheap-john" equipment for farmers' lines. The truth is, that for many reasons, the farmer ought to have better equipment than anybody else. It is very much more difficult for him to get repairs than it is for any one else; and besides, in the very nature of things, he soon becomes very much more dependent upon his telephone than does the man living in the city, where distances between business associates and neighbors are very much less, and where other facilities for communication are very much more numerous.

Another explanation for bad equipment in the country is the very short-sighted practice indulged in by some city companies of selling their worn-out material to farmers, at reduced prices. A chain is only as strong as its weakest link; the 'phone or switchboard that is not fit for use in town is certainly not fit for use in the country. "Good equipment everywhere" should be the motto. The battlefield of the great telephone war, which has been raging in this country for the past five years — with the victories always on the same side — has been largely transferred from the cities to the country. The Bell companies, in the days of their monopoly — and, in fact, until quite recently — positively refused to furnish service to the farmer upon any terms. Now they have changed their minds about that, and seem to have concluded that the farmer and the villager are not such bad fellows, after all. But their repentance has come too late. The farmer and the villager have been doing a thing or two for themselves in the meantime. And this is part of what they have done in Indiana. I feel that you will pardon me for talking a little about my own State.

We have had a most desperate fight in Indiana for the past five years — notably for the past two years. We have been threatened by the opposition with everything, from total annihilation to everlasting abode in eternal darkness. We were assured, upon the honor of the very clever gentlemen who manage the Central Union Telephone Company, that we would lose every dollar we put into the telephone business; with the further cheerful assurance that they knew what they were talking about and would personally see to it that their predictions would come true. In furtherance of this last determination, they spent a good deal of their "war appropriation" in superhuman efforts to prevent our people from putting money into the telephone business. It would be amusing, now, to read some of their statements. They would make the man who was expelled from Hades for incurable falsification green with envy. We learned long ago in Indiana, that the immortal Lincoln was right when he said that, while one might fool part of the people all the time, and all of the people part of the time, he could not fool all the people all the time.

When the first independent telephone exchange was constructed in Indiana, the Central Union Telephone Company had been paying, for twelve years, on a capital of $6,300,000 (three-fifths of which was pure water) annual dividends ranging from four to six per cent. They had no bonded indebtedness and no floating indebtedness that was reported. When the fight with the independents began, they ceased paying dividends, the last one being paid in 1895. In 1897 they borrowed $2,500,000; in 1899 they borrowed $6,000,000 — $2,500,000 of which was set aside to pay the holders of the first mortgage of $2,500,000. They now have, in addition to this $6,000,000 mortgage (according to recent publications) a floating indebtedness of $1,250,000.

Now let me tell you what all this has resulted in. The Central Union now has (as shown by their own figures) 22,000 telephones in the State.

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(The real number is smaller than this, but we can afford to be generous, and I propose to give them all they claim.) The independent telephone interests have in the State of Indiana, by actual count, 52,469 telephones. I know you will excuse me if I repeat those figures. *After a "war expenditure" of $7,250-000, begun upon the independent movement when there were less than three thousand independent telephones in the State — the Central Union now has, for its expenditure, 22,000 telephones and the independent movement has 52,469.*

The total population of Indiana (according to the census of 1900) is 2,516,-000. There are ninety-two counties in the State, and there are twenty-seven of these in which the Central Union (or any other Bell company) has no exchange, large or small. The population of these twenty-seven counties aggregates 491,000, and the aggregate number of independent telephones in these twenty-seven counties is 14,262. The total number of Central Union and other Bell company telephones, used at toll stations only, in these twenty-seven counties is 197.

I submit this Indiana statement more especially for the benefit of our friends, in different parts of the country, who are just beginning their fight with the great monopoly. If you ask me how they fought us I can simply say — every way. If there is any mode of guerrilla warfare that they left untried, we have not yet been able to find it. The independent development in Indiana has been accomplished by Indiana self-hopefulness and Indiana capital. Of the millions invested in the independent telephone business in Indiana, less than $100,000 has come from outside of the State. More than that, the business is practically out of debt. The total indebtedness upon the Indiana independent telephone property is less than ten per cent of its total value.

In this great success the farmers and villagers of the State have been of incalculable help. They realized (as all sensible men, similarly situated, must have realized) that their only hope was in becoming a part and parcel of the great independent movement. The independent movement gives opportunity for self-helpfulness and intelligent co-operation. That which a man can do for himself, is most likely to be quickest done. The flexibility of the independent plan is its greatest recommendation. There is no honest local movement that can not find a warm welcome and a happy home in it.

It will not do to say that good service can not be given by the independents. Every unprejudiced man will say that the most indifferent independent service in the country today is very much better than the average Bell service was when the independent movement began.

The Bell companies, all over the country, are paying us the delicate compliment of imitation in many things, but more especially in their attention to the farmers and villagers, whom, in their halcyon monopolistic days, they so severely let alone.

I would advise our former friends, the country over, to be a little skeptical about this death-bed repentance.

"When the devil was sick,
The devil a monk would be;
But, when the devil got well.
The devil a monk was he."

DISCUSSION ON VILLAGE EXCHANGES AND FARMERS' LINES.

BY J. B. WARE.

Mr. Sheerin has presented in such an able manner this subject that it is exceedingly difficult to discuss the paper except in a few minor particulars. There is no question but what the farmers' telephone is of greater importance to the entire telephone situation at the present time than the majority of us realize. There is a tendency in certain districts, because of lack of communication by telephone, for the farmers to look after their own interests and develop that phase of business themselves. This has resulted in the establishing of a mutual or coöperative form of telephone business with poor construction, the one object being to secure communication with neighbors. This kind of service is conducted, not upon a business basis, but upon more of a social basis. The rates are merely sufficient

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to pay the actual expenses of maintenance, and the maintenance is performed in as limited a manner as possible, with the result that an inferior service has been secured. The cost of the service, however, is so slight that those who thus build their own lines — and we naturally think more of our own than we do of that which belongs to others — have become satisfied to an extent with the conditions. If they are able in an emergency to reach their doctor or to call upon their neighbors for assistance they see the advantage to be so great that they are contented, and continue under conditions which are extremely unfortunate for the entire telephone movement. In other words, the farmers' telephone business naturally divides itself into two classes: First, the farmer who resides in the neighborhood of a large city or exchange of importance, so that his communication is desired particularly to that exchange center for commercial and business purposes largely. There is no difficulty in providing the metallic circuits, good bridging 'phones, if party lines are used, and giving service which is entirely satisfactory to the farmers and at a price which is, in a general sense, satisfactory to the exchange owner. With that class of rural telephones we are having no particular trouble. But the second class are what might be termed the social class of farmers, who do not live in the vicinity of a large city, who have no produce to market, who do not see the advantages of a good telephone service, as a general rule.

I was very much surprised a few months ago in discussing the matter of farm telephones with a man who has built a number of such social farmers' lines having from twelve to twenty-five telephones on a single ground-wire circuit. I urged the advisability of putting up metallic circuits with not over six instruments on a line. He said to me, "Mr. Ware, you don't understand the farmers' proposition. You go out in that neighborhood, promise them a metallic service with six telephones on a line, and I will follow and give them the same rate and promise them twenty on a line, and I will get more contracts than you will get." And he was right, because what they wanted was to have as many farmers on a line as possible, for social purposes. Now you and I can scarcely realize — at least I have had great difficulty in realizing that phase of the telephone business — that what they wanted was not the commercial advantages but social advantages. The evil of that is this — no company desiring good service can afford to build that class of telephone lines from a business standpoint.

The farmer has had no outlet, as I mentioned, and the result is that he and his neighbors have cut some slim hardwood poles, just as Mr. Sheerin graphically described; and they bought their telephones at $8, $12 or $15 and connected them by steel and often fence wire; and they are actually talking over this class of lines. Their example has inspired the neighbors over in the next township to do likewise, and it has spread until a large portion of the county has been covered with this social telephone system. Some farmer will consent to allow both lines to center in his house; he has a family sufficiently large to take care of the switching as an accommodation, and the result is that a man talks ten or even twenty miles, over two or three circuits, to another farmer perhaps on the other side of an exchange, and it actually costs him nothing. The evils of this free service are apparent to every man in the room. You can not develop a toll-line system to compete with this class of telephone service. I have great confidence, however, in the development of these communities along the line of good service. Free toll or exchange service can not be given and secure good service. The independent companies have made perhaps one mistake more frequently than others in establishing rates that are too low. I am talking particularly of my own State, Michigan. Other States, I hope, are getting larger rates, but in Michigan $12 is the limit for telephone service in farmers' communities, and there are a large number of communities where a less price is maintained. I believe that that class

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of farmers who use their telephones for commercial purposes; who are not fully realizing the advantages to be gained by telephones in their residences; who are unwilling to pay more than $12 and are now satisfied to go on party lines, will, in two or three years, or at the outside five years, demand of you gentlemen that they be given separate lines at higher, yet reasonable prices. In other words, my opinion is, and I believe yours is, that outside of this social farmers' element, the farmers will want separate lines or party lines with but two or three instruments.

This means that where we have pole lines with 4½ and 5 inch tops, pole lines with two, four or six wires upon them with perhaps 6-pin cross-arms, in the next two or three years we are going to be compelled to furnish additional circuits. We are in the business from a financial standpoint; we want to get as high rates as are reasonable and fair. The farmers will find that they can not do business satisfactorily over party lines. Already in portions of Michigan that tendency is manifest, to change from party lines to individual circuits.

Now then, what is the lesson as to construction? Simply this, if you are able financially to do it, do it right; if you are not, you ought not to do it at all. You ought to put poles up large enough to carry 10-pin cross-arms, and pole lines should be run with the expectation that the wires are going to double or treble in number in the future. That fact is an advantage and a very large advantage to the telephone business, because as subscribers require these separate lines they are willing to pay higher rates, and it gives us a chance to grow properly. They will pay rates that will give a reasonable return upon the investment, and every honest farmer and business man expects the telephone men to have a reasonable return upon their investments.

I am deeply impressed with the correctness of the statement made by Mr. Sheerin, that the farmers' telephones have proven of such immense value to the independents in the past and that the Bell companies, or at least a portion of them, have reached the point of realizing the importance of this class of business. I am delighted to be informed that the $100,000 president of the Central Union and Chicago and other Bell interests is opposed bitterly to farmers' lines, and in Indiana has recently caused them to be cut down in some instances. It is the best thing that could happen to the opponents of these Bell companies, because there is no way, in my judgment, for the Bell licensee companies ever to drive out independent companies except by getting the farmers' 'phones and forcing the citizens of the cities, towns and villages to take Bell telephones in order to reach their farmer relatives and friends. This rural business has heretofore been secured only by the independents, in many sections thus heading off the possibility of Bell competition. But, gentlemen, there are a large number of independent companies that have not developed the farmers' communities. Now farmers' telephones, properly handled, are profitable, and they strengthen the exchanges in a way one can not realize until you have actually developed the rural territory. You must take care of your farmers, first, for your own good and for their good, and second, to weaken the enemy. If you do not do it this year, you will find the Bell companies will do it next year. They are at a point where they must do something, and I look, before this year expires, for a great development thruout their territory along the lines of farmers' telephones by all the Bell licensee companies. I am glad that in the territory with which I have been connected the farmers have been taken care of as a rule. The strength and success of the exchanges on the western side of the State, and in the central portion of Michigan, is owing largely to the fact that the farmers have been connected up only with the local independent exchanges. But it pays to do what Mr. Sheerin says — it pays to build right; it saves rebuilding; it is economy in operation. It does not pay to buy inferior apparatus, and if there is any apparatus superior to others it should be used on farmers' lines.

What has been said of farmers' lines

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is true to a very great extent of small village exchanges. I like the idea of connecting but a few on a line, running numerous lines to the farmers' exchange and then have trunking lines to the city or village exchange.

Personally I want to thank the writer of that article for the very excellent paper, and I want to say in conclusion to this, that we have found in Michigan not only the truth of the statement made by Mr. Sheerin as to quality of service comparatively between independents and Bell, but we find that the independent service in Michigan is better than the Bell in almost every instance. I do not know of an exception, and I challenge any man in this room to find an important instance in which the independent service is inferior to the Bell. The apparatus used by the independents is the equal in quality, and in many instances superior to that used by Bell companies in a large portion of the territory developed. This is as a rule true as to the character of construction of all large independent companies, as compared with Bell construction. There is no reason why we should not continue to keep ahead of the Bell in the next two years in telephone development, as the quality of apparatus and construction of our plants is the most modern. There is no question about the final outcome, because we have the men and the material and the apparatus with which to give the very best service.

I thank you.

REMARKS BY T. J. FRICKER.

MR. PRESIDENT AND GENTLEMEN,—I have been trying for an hour to find this hall. I had not the least idea that it was in the residence portion of the city. I have been all around the docks, have been transferred by two or three different railways to different lines, and at last I walked up here. I regret exceedingly that I was not here to listen to the paper that has been read on one of the most vital topics that comes before the Independent Telephone Association. I want to say to you that having been notified that I was to speak to you I went down to where speeches are sold and found that every one had been sold and used by gentlemen upon this platform, therefore, gentlemen, what I say to you must come direct from the heart, or from the brain; sometimes we do not locate them in the right place. In order to justify myself I should further say to you that I had not the least idea that I was to say one word before you until yesterday, when a gentleman called my attention to one of his programs which I had not seen. A brother of mine who is secretary of the company of which I have the privilege, and I must say the honor, of being president, received a program and kept it himself. I am to discuss a paper that I did not hear read. I want to say to the association, however, that if there is a single advocate of independent telephony in the United States today that is strong in the conviction that she is right against the great octopus that has been upon the people, I am one of them. If there is any branch or subject of independent telephony that you want to get light upon, what is it? If there is any particular subject that is uppermost in your minds concerning which you desire light, what is it? Lucifer said, "Let there be light," and light there was. If you want more light on this subject in any of its various phases, indicate what it is and I will give it to you.

But before proceeding to discuss the question I want to supplement what has been read as to the decision of Judge Phillipps by saying that one of the best courts in the United States is in the State of Michigan. The Supreme Court of that State decided about one month ago that telephone, telegraph and electric railways had the right to cut every branch from a tree that it was necessary to remove for the purpose of carrying out the purposes for which their franchises were granted. I am also engaged in the electric railway business. I recall that along a street where we were building there were seventy-four maple trees and we cut them every one down because they were so far on the highway as to interfere with the purpose for which the street was dedi-

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cated. This decision I think you will find in the *Review* for May. I simply want to speak of Judge Phillipps' decision. I think it is an advance decision and is one that I hope will be carried up to our higher courts in the State of Ohio. There is no question but that the statutes of Ohio are exceedingly stringent against interfering with private property in the construction of telephone or telegraph lines, and before going any further I want to say that I believe it is to our interest and to the public's interest that some measure shall be taken by our incoming legislature when they are assembled, more advantageous with reference to country highways than any on the statutes today. They are against us and we should require what is absolutely necessary. Such legislation will give us such rights. To diverge a little again, we have had an instance in the construction of our electric railway. On the right side of the road was an independent telephone line — seven miles of poles belonging to my company. These poles were where every one had to be removed to the opposite side of the street, as the high tension current transmitted over our own wires from the telephone wires would have made it dangerous. We did not have the least objection from a single property owner until we reached one of my own company upon whose premises seventeen poles were to be set. Now, I said to our pole men that they should go and move every other pole, leaving the lines for operation on the poles that were standing. They did so until they came to this man's property; there we took out five poles and left the balance standing. The next morning every solitary pole had disappeared. We hunted around the neighborhood but not a pole could be found and report was made of this fact. I said, "All right, I will get a horse and drive over." The man's wife said in answer to an inquiry as to his whereabouts, that she did not know where he was. I asked where the hired man was and she said she did not know. I said that she was like the woman whose husband had joined the Masonic order and upon being asked if he belonged to the Masonic lodge replied, "I don't know, he doesn't lodge here." At last I found him in a field more than a mile away. I said to him, "Those four or five poles that were in our line there are missing and we want them brought back." He denied knowing anything about them. I said, "That question does not enter into it. I insist that the poles shall be returned." He was drilling corn at 50 cents an acre. I told him I did not care how expensive it was to quit, it was the lost poles I was after. The result was that he unhitched his horses, driving thru fields in his hurry for fear an officer might take him in. He found the five poles and put them in the very holes that had been dug for them. To cross that farm required sixteen or eighteen poles and every pole had been set. All that is necessary when you want to bring a man to time is to make him believe you have rights whether you have any or not.

Now, gentlemen, I am extremely pleased to appear before you today. There is no one thing more gratifying to me than to see this fifth national assembly of the independent telephone people of this United States assembled in this beautiful city today, and one of the most gratifying features of this whole thing is the fact that I see today among our midst the same gentlemen whom we have seen with us for five consecutive years. What does it mean? It means simply that your investments, your interests in independent telephony of the United States was not of a transient character. I dare say, as I look on you today, that there are not to exceed a score who make independent telephony a business of itself. I believe with most all of you it is a side issue, it is not your life business, you are not devoting your entire time and attention to it if you have taken an interest in it, and that fact that you are assembled here today is a stimulus to the rest of us who have entered in the early days and have continued in it to this day. A great German professor once said, "When appearing in a school among urchins whose feet barely touch the floor — when I look upon an audience like this of those children, I feel like

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taking off my hat, for I look upon the rulers of the nation that are to come." When I look upon this audience I see the men who will control the telephone situation in America in years to come. There is no question of it. Who would have believed five years ago, when the first national association was held, that each and every one of you today would stand up and enumerate any such number of connections with your switchboards as you have today? Who would have believed that we could sit in our offices and homes and talk over the country to the extent we have? And we could not have done so had it not been for the persistent effort, the untiring effort of such men as this gentleman who sits before you today — Judge Thomas — and there is a score which I spoke of a moment ago, but uppermost of all sits Judge Thomas. His efforts and a few of the men who have gathered about him are the men who have given us today what we call the long-distance connection. Have you ever thought for a moment, gentlemen, how many there are who have built exchanges who would have simply given up or been wiped out for fear on the part of your subscribers and stockholders if it had not been for this national association? I would like to know how many people there are here today who have ever had the question come up at their stockholders' meeting or directors' meeting, the question of injunction or what the result would be if the Bell Company were to get out an injunction. I know that question has arisen in ours. I said to them that the national association would take care of it. We started with 125 connections, we have today 900, and we can not take care of them. We have laid out and rebuilt a three-story building for our use, the two upper stories of it we will use for our exchange. Starting with 125 do you believe we could ever have done this if it had not been for the national association? No, sir, there is not an honest man here who believes this could ever have been done if it had not been for the national association. I know in these different gatherings we have said, "What benefit do we get from this national association?" If you do not get any other, gentlemen, your allegiance should be so fixed that you should never lose it, if for no other purpose than that you have been fostered in your infancy and have been protected against any local litigation that may have been brought against you by the Bell Company. That single item in itself is enough to warrant you in continuing your allegiance to the national association; but that is not all of it. How many of you are there who have gone to subscribers or those whom you hoped to be subscribers, who use long-distance lines, and they have said to you, when you can give us this place or when you can give us that place we will take a telephone? There was no Federal, no United States companies then in existence. They sprung into life later, and they are today what has given us prestige in our own individual localities, and they are still extending their lines, and it will not be many years until, like the Bell Company, you can talk to any metropolis in the United States. I believe — always have believed — that these things were not sufficiently impressed upon your minds. Those of you who heard my feeble voice at every convention will remember that I never turned away from that line.

I regret I have not been able to discuss the paper, for the subject of farmers' lines is of vital importance. A few years ago such an expression was not known — farmers' lines. Five years ago the term farmers' lines would have raised a point of inquiry. Many of you today know what it is. How many are there today in whose localities the Bell people are formulating a plan to establish farmers' lines? What is the object of it? They are trying by this means to force the people in the cities and villages to take their 'phones. They are seeking today to establish farmers' lines, many of them on a line. You have got to entertain the proposition and take it up. If you do not they will come in and take it up against you.

Now, there is another proposition. Two years ago, perhaps, I spoke to you with reference to telephone girls. If

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there is any one thing that is essential to the success of your exchange it is the girl who answers the subscribers in your exchange. If there is any fault found with your management today and brought to the attention of your local officials is it not as much the fault of the girl who operates in your exchange as from any other cause? Is not the majority of the multiplicity of complaints that come before his attention of the girls in your exchange? You have invested thousands of dollars in switchboards, you have invested a like amount in poles and lines, and when you come to place your National Bank, as it were, with all his capital, in the hands of an inefficient cashier, who for a moment would think of it? Not one of you as business men, and the moment you invest thousands in switchboard and poles and line construction, and then place the full operation of this investment in the hands of inefficient girls sitting at your switchboard, you make a sad and furious blunder. Now you can not do too much for them; $3 a week, $4 a week, $5 a week — what do they do for you? They return you your dividends, they increase your subscription list, they make all there is of your exchange. It is she that answers back and says "Number?" That either makes or defeats your exchange, and next to the homage you pay to your wife and mother pay it to the girl who sits at the board and operates your exchange. Extend and afford her all the comforts within your reach, do not overwork her, and if you take your hat off to any lady take it off to the one who is serving you in your exchange. Extend to her all the comforts, everything that is possible in order to make her efficient; it is money well invested. No question of it; those of you who have employed these tactics know it; those of you who have failed may well hide your faces in shame. I hope there are none. I would not believe that men who year after year leave their places and leave their offices and come to this three or four days of convention, I would not believe that such a class of men would for a moment treat any of their employes other than they ought to be treated. But if any of you have, or are tempted to do so in the future, just look at me and just think for a moment that your treatment of them is nothing as compared with what I would do to you if I knew it.

Now I do not think of anything further I can say, gentlemen. I will not take any more of your time, but if any gentlemen want to ask me any questions that may have arisen in the paper that has been read here I would like to answer it if I can.

I thank you all for your attention.

REMARKS BY CHAS. E. WILSON.

MR. CHAIRMAN AND GENTLEMEN,— Our plant in Philadelphia will be in operation by October, if our contracts for cable and switchboard do not disappoint us. We would like to invite you to hold your next convention in Philadelphia. Philadelphia has quite a reputation as a convention city, has fine drives and claims the finest park in the United States. If your executive committee can see its way clear to come to Philadelphia for your next meeting, I will guarantee on behalf of our company to provide ways and means of seeing these parks, provide a meeting hall and an excursion on the Delaware. I think it might be a good idea to make the trip to Atlantic City from there, as I presume many of your members have never been to Atlantic City, which is one of the foremost resorts in the United States. I understand the question of selecting the place of meeting is left with the advisory board. I just wish to ask at this time that those in favor of Philadelphia use their influence with the board to have them call the meeting at that place.

Our conduit system and cables are laid out for an ultimate capacity of 30,000. We are erecting no poles, making all of our house connections underground. We have most of our conduit work done. Everything has been prepared and we can assure you that there is no question about there being independent service within the year. We have something over four thousand contracts now, all five-year contracts.

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We are getting contracts at the rate of seventy-five to eighty per day, averaging two contracts per man per day. The Bell Company had in January 10,025, the city having a population of 1,320,000. We consider that we have a most modern telephone plant from an engineer's point of view. We have the Kellogg boards, and the telephones we designed ourselves and get them manufactured on our own specifications, our engineering department doing the designing.

Our business rate for single-party lines is $80; two-party line, business, $52; residence rate, single-party line, $48; two-party line, $36; nothing more than two-party lines. The Bell Company charges $160 for unlimited business service. Their residence service is measured, a good many party lines in the suburbs with four or six on a line and they are not giving satisfaction. They have been putting in 'phones free for some time, taking a contract for a year and give service for six months free. This does not seem to be interfering with our progress.

REMARKS OF C. E. STINSON.

I am not exactly prepared to discuss the paper prepared by Senator Kline, of Pennsylvania, but I will make a few remarks in regard to the Rochester Telephone Company, not about what we are going to do, but will tell you what we have done. Fifteen of the prominent citizens of Rochester came together in May, 1899. They decided that the service given by the Bell Telephone Company, of Rochester, was very inferior service. The company was organized at that time and application made to the city for a franchise. After considerable trouble in seeing several people a proper proposition was made to the city, in which the Rochester Telephone Company agreed to furnish 1,500 bona fide contracts and present them to the mayor. In addition to this they agreed to give the city of Rochester forty-three telephones in consideration of this franchise. Solicitors were sent out and contracts secured without any trouble. They were presented to the mayor and the franchise was granted. Material for construction was at once ordered and the work was started. All the material was ordered on September 1 and enough to finish the whole plant. On October 6 construction had started. In the meantime the lot had been bought for the building, and a two-story building was erected. On May 10 the following year the exchange was opened with 1,700 subscribers. The construction at that time was laid out for the equipment of about 2,500 telephones, the Bell Company having in the city of Rochester about 2,200. About 1,600 were of what is known as the party-line system, five and six on a line. The rates at that time for the Bell were $64 for an unlimited, metallic-circuit service for residences, and $84 for business. The rates for the Rochester Telephone Company, which were agreed upon in the franchise, were placed at unlimited service for $48 for business, $30 and $24 for residence, no party lines at all. The $24 rate includes everything within a mile of the exchange, the $30 rate takes in everything outside of the mile and within the city limits. On May 10, as I stated, the exchange was opened with 1,700 subscribers. The business increased so rapidly that on three different occasions I have been compelled to enlarge the cable capacity. The switchboard had a capacity for 3,600, equipped at that time for 2,500. I saw the increase coming and added 500 lines. I had not the equipment ready, however, when I had to increase to 3,600 lines, the ultimate capacity of the board today. We have today 3,700 subscribers. The Bell claim possibly 2,200, but I do not think they collect rentals enough in the city of Rochester to meet the pay-roll. They are giving service for three months for a year's contract, putting in what is known as the American message service, placing a telephone in everybody's house, particularly where we have taken them out for non-payment of rental, and establishing there a nickel-in-the-slot machine.

We know and we feel that we are doing the business of Rochester. We are answering today, on an equipment of 3,600 lines, 50,000 calls in ten hours

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or 60,000 in twenty-four hours. The unlimited service accounts for this of course. We are operating several small branch exchanges on account of the sudden landslide in business filling up our equipment.

Another thing we have done in Rochester, we have installed 250,000 feet standard underground cable in the conduits with high and low tension wires. This matter has been before the courts for some time. The city of Rochester served an injunction on the Bell Company restraining them from building any more conduits. The result is they put up the claim that it was extremely dangerous and that we would set fire to the town, kill everybody, etc. The restrictions that have been placed upon us are very severe. We have been compelled to do all the inside wiring under the specifications of the State Board of Underwriters. The 250,000 feet of cable is now in operation and has been since the opening of our exchange. We have no induction, no disturbing element of any kind, and we parallel these high tension wires.

The citizens of Rochester have supported us at every step, they have taken a great interest in our exchange. We occasionally have visiting days, and on our anniversary opening day this year we had 15,000 people visit us from the city of Rochester, and there is not a day that we do not have a number of subscribers call. Our policy is not oppressive, it is to treat the people with all due respect they are entitled to. Rochester, several years ago, you will remember, had some trouble with the Bell people. What is now called a strike had taken place there between the Bell and their subscribers. The Bell demanded that which the people thought was not right, and every one hung up his telephone receiver and for six months there was not a telephone in Rochester that was used. The Bell people in Rochester have lost all their prestige on account of the tactics they have used. They have changed local managers three times within the last year and a half, which would indicate that something is wrong.

In addition to our Rochester exchange we have been rather slow in extending our toll lines, for the reason that we have increased our capacity from 1,700 to 3,600 in one year; we have added 2,000 telephones; so you can readily see that the work in Rochester did not give me much time to look after toll lines, altho I have about 160 miles of poles.

When a new company was first talked of in Rochester the Bell people thought at that time that it was impossible for any independent company to build a plant, at least within five years, and they were not prepared for what has taken place. They told the people we could not get a switchboard — they covered all the patents. They also informed them, after contracts had been given for switchboard and cable, that the system which we had adopted could not work in an exchange of that size. Well, we opened our exchange and everything worked all right. They tried to block us in our construction in every respect, as you are all familiar with. In one instance a building which we wished to contract for had about one hundred Bell telephones in it. They entered the building thru aërial service. I went to the owner of that building, laid out a plan of distribution, showed I would come in underground, and the proposition I made to him was accepted upon these terms — that whatever we distributed thruout the building in the way of conduits we should jointly allow the Bell telephone to occupy. This I agreed to. The result was I wired this building, put in the conduits, the installation was made and the service opened. The Bell people then went to their subscribers in this building, stating that the owner of this building had compelled them to occupy this same conduit with the independent telephone wires, and that it was very dangerous to occupy a conduit with high tension wires. It did not seem to worry any of the people. The result was the Bell stated if they were not allowed to enter the building some other way they would remove their telephones, and they found they would have to enter our conduit or go out of the building. They finally concluded the best way was to pay their share of the conduit.

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The construction of toll lines around Rochester, and in fact Buffalo, is a hard proposition. The roads are crooked, hilly and very thickly settled with trees, and the property owner, as a rule, objects to any more poles and strenuously objects to the trimming of trees. We find in all cases we have to buy right of way. The consideration, of course, varies, and this is one reason why we have not what is commonly called farmers' lines, but we have everything covered within a radius of eight miles and we term them "farmers' lines," but our farmers' rates are a little different. Our toll lines are all constructed of 25-foot poles, 6-inch tops, with 10-pin cross-arms, full copper wires, six instruments on a line. The rates for these are $40 and $50 on five-year contract, and we do not think there is much money in a $12 rate around our place; and this is perhaps one reason we have not got as many farmers' lines as many other companies. However, we do not think we will change our rates; we prefer to build good construction and then make the rates as low as possible and get a reasonable return on our investment.

In regard to the service of an independent telephone company — it is dependent to a large extent on the operating department. I have paid particular attention to the service. The morning we opened our exchange twenty-seven of the Bell operators walked over and went to work, among them some who had been called down many times for the service they had given. When employed by our company we presented a set of rules. The result is they have all complied with these rules, and we believe we are giving as good service as any exchange in the country. The salary paid to these operators is perhaps a little higher than many of the companies pay. Our salary per operator would average $5.44 per week. We have taken care of the maintenance of our plant with two trouble men, one instrument man and two inspectors.

In reply to Mr. Wilson's invitation to hold the next convention at Philadelphia, not wishing to oppose him in any way, I would invite the next convention to be held at Rochester. Of course it is a little near to Buffalo, and I do not know as we have especially fine parks to show you, but we can show you what we think is a nice independent exchange.

TELEPHONE DEVELOPMENT EAST OF THE ALLEGHENIES.

BY C. W. KLINE.

BUFFALO, N. Y., June 12, 1901.

MR. PRESIDENT,— I have been invited to tell you something about the development of the independent telephone east of the Alleghenies. The subject is one that appeals to me strongly, and I am sorry that lack of time prevents me from doing full justice to the subject.

About five years ago the question of better and cheaper telephone facilities came under discussion in what is known as the East. The result of the discussion was that here and there small plants were installed and in a small way local service was instituted. The first plants were crude, the switchboards somewhat inferior, the material, I am sorry to say, not of the best, but at any rate in even this inferior construction and poor equipment it was found that as good, if not better, service was given than had ever been received from the Bell companies; and even under adverse circumstances the plants held their own, and in nearly every instance doubled or trebled the number of telephones owned by their rivals. The people — the business world — were with the independent companies. The Bell monopoly had disregarded their needs, charged exorbitant prices for inferior service, cared nothing for their necessities, so they were ready to welcome competition, which they firmly believed could only result in benefiting them. So, from the very start, the cause of independent telephony was made the cause of the people and results today amply demonstrate that the people were right and human progress received another strong push upward and onward. While our infant plants were struggling for existence — were trying to bring order out of chaos and carry out promises to

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the public, they were encouraged and sustained in their efforts by news that floated across the Alleghenies from the giant West, where earlier efforts had been instituted along independent telephone lines. They told us, first, that their plants were successfully working and soon came the glad news that at the reduced rates they were giving the public the plants were paying a fair return to the investor. This was all that was needed to give impetus to the movement in the East. Soon larger plants were installed and the question of local toll lines was being discussed, and the question of securing franchises for the large cities was undertaken. This in many instances was found to be an extremely difficult task. A rival firmly intrenched, with unlimited financial backing, threw every obstacle in our way, but we worked steadily on (in some instances it has taken three years to get a franchise). But with a persistence and energy that would not allow defeat and failure, the fight was kept up until monopoly and corruption went down before our just claims, and today the independents have a franchise in every large city, excepting Washington, east of the Alleghenies, and not only in the large cities, but in the boroughs, towns, hamlets and villages, at the cross-roads and leading farms the tinkle of the call of the telephone bell is heard everywhere, bringing our East so near together that we are all neighbors. Already plans are prepared and the routes surveyed across the Alleghenies that will link the East with the West, and we hope by the time of the meeting of the next annual convention that Boston, New York, Philadelphia and Baltimore, and all surrounding territory will be greeted by the trainman's cry, "These toll lines for Pittsburg and the West." While much has been accomplished in a very short time, much still remains to be done. Some of our principal cities are fully built and some are building — all are in motion. Under the splendid management of S. E. Wayland superb plants have been installed in Scranton and Wilkesbarre, Pennsylvania, covering the Lackawanna and Wyoming valleys with an easy possibility of 30,000 'phones in sight and 7,000 'phones now at work. Allentown, the center of the Lehigh telephone system, with a possibility of 5,000 'phones with about 1,800 installed, has a splendid system, well built and equipped. Then Reading, which is being built; Easton, working the lower Lehigh; the Overland, of Lehighton, reaches out its tentacles for everything in sight; the Anthracite, of Hazleton, embracing everything in Lower Luzerne, Upper Carbon, and northern Schuylkill counties; the Standard, of Bucks and Montgomery, now being rebuilt by G. S. W. Brubaker, covering all that section; the United Telephone Companies, embracing Norristown, West Chester, Lancaster, Lebanon, all of the Schuylkill, Northumberland, Montour and Columbia counties and the north and west branches of the Susquehanna. Harrisburg is building and Columbia and York, connected via Carlisle with Chambersburg, extending its lines in every direction in York and Lancaster counties, and connected west to the Alleghenies. Philadelphia, under the able management of C. E. Wilson, general manager, is building one of the finest plants in the world. All of New Jersey is awake, and up and doing. Every town in the State has an independent plant and they are giving good service. Fine plants have been installed at Rochester and Albany, which we understand are giving good service from the Hudson to the Mohawk Valley. The United Telephone Company of Pennsylvania, cover the southern portion of New York State. The Maryland Telephone & Telegraph Company has a splendid plant at Baltimore, and the chain of independent companies stretch south along the Atlantic to the Gulf of Mexico. New York city, the metropolis of our land, has awakened from her lethargy and we are promised in the very near future a thoro, complete service. The New England States are falling in line and new plants are being constantly installed, and some very good ones are already in operation. Boston, the "Hub of the Universe," already has a finely installed system and is enlarging

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and perfecting it. So we say to our friends from the West of the Alleghenies that there is something doing in the independent telephone world east of the Alleghenies. While local plants have been successfully installed everywhere, except in a very few isolated instances, we are beating our older rival on the general average at least of three to one, and I predict that in a very short time that the territory east of the Alleghenies in Pennsylvania, my native State, will have more independent telephones than the Bell has in the same State both east and west of the Alleghenies.

Now, while we are quite long on local plants we are yet a little short on toll lines, but we are trying to remedy this as fast as possible. Already the Interstate Telephone & Telegraph Company has built lines in the east portion of the State of Pennsylvania, connecting up the entire eastern portion of the State with some 14,000 'phones, and has its terminal facing New York city at Trenton, and traveling along for twenty miles along the outer edge of Philadelphia, ready to jump in and connect with the first telephone installed there. They connect at Trenton with the lines of the State Telephone Company, of New Jersey, that extends from Trenton to Jersey City. The Interstate is ambitious and willing, ready to contract with and extend its lines to exchanges wherever needed, ready to cross the Alleghenies and make the chain complete that shall unite the West with the East — a grand telephonic brotherhood; but to do this successfully they must have the contract of all the independent companies along their pathway as well as their encouragement and good will. The difficulty with the toll-line question and the obstacle that has so far retarded its progress is founded on the inherent selfishness of humanity. We have too many companies ambitious to control the toll-line situation in the East, and it will take a little time to reconcile the differences and brush away the selfishness. All this we hope will take care of itself, because we believe that fairminded men can meet and agree on what is mine and thine in regard to the territory; and having so agreed they can pool their interests and bury their differences. We can not afford to fight among ourselves; we should try to remember that we have a resourceful business foe to oppose our every forward movement, and that we must stand together if we would deserve success.

Now, gentlemen from the West, the East salutes you and assures you of that most distinguished consideration. While we may have seemed a little slow at the start, we warn you to look well to your laurels or we will surely overtake and pass you in the march to telephonic perfection. We expect the time to come in the very near future when telephones in the East will be as common as shoes and twice as necessary, and to that end our efforts will be concentrated. We say to our friends, North, South and West, the territory east of the Alleghenies is all right telephonically; 50,000 telephones are tinkling at the call of subscribers. We are right in the great independent telephone procession and we mean to get to the right of the line and stay there.

LEGISLATION AND LITIGATION.

BY H. D. CRITCHFIELD.

I want first to thank the President of the convention for making the statement he has just made to you, and while I do not seek to add anything by way of apology, I do regret that I was not in a position to prepare a paper upon the subject that was assigned me. However, that was impossible, as it would involve getting much data, dates, names and places which I was not in possession of here and in no position to become possessed of, and therefore the paper has not been prepared. But in order to fill the program I will ask your indulgence while I make a few extemporaneous remarks, which, for the reason before given must necessarily be general in character.

Had I been present at the meeting of the advisory board which assigned the topics for discussion I think I should have opposed a paper on this subject for two reasons: first, we do not need much

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legislation and we do not want any litigation; secondly, if we are forced into either, we do not want to advise our opponents in advance of what we want and what we do not want them to do, and what steps we propose to take in event they do certain things. I say it kindly, but I think a full discussion of this subject would be ill advised.

Now, upon legislation there seems to be one topic which is of general interest to many of the gentlemen who are here, and that is, legislation affecting right of way on public highways. There seems to be a popular opinion or impression that the legislatures of the respective States have the power by enactment of laws to take from the owners of private property that property without compensation or due process of law. It seems to be universally held by the courts that the owner of the land abutting on the highway (except in cases where the grant was unconditional, which are rare), is the owner of the soil upon which the road is laid out (the owner of the fee), subject to the right of the public to use the same for purposes of travel. That being true, gentlemen, the provision which is contained in the constitutions of the several States, in effect, that there shall be no taking of private property without due process of law, which means a determination by a court and jury of the value of the property sought to be taken, would prohibit the legislature to do anything other than give to the telephone companies the right of eminent domain, which is conferred upon corporations in almost all States. The legislature has no power, as a general proposition, to do more than to give you the right to put your lines upon the highway, subject to the litigations, however, which have been suggested; that is, if you want to place your poles on the highway you must have the consent of the owner of the property, and also shall so place them as not to impair the highway for the purpose of travel. I think that may be taken as a general proposition to be true, and it is true that there is but one thing to do, and that is to be as diplomatic as you possibly can in getting your right of way. Another suggestion which I think is worth while to make is this: Agricultural papers in some sections of the country and demagogues have been advising the farmer to "hold up" these "soulless corporations," and make them pay $10, $25 or $50 a pole if they want to put their line along in front of their farm, and it is very much more difficult to get right of way on the highway now than it was one year ago; it was very much harder to get it last year than it was two years ago, and next year it will be almost impossible. Therefore get your right of way and get it just as soon as you can, whether you are going to build this year or not. Determine your lines and get it now before the opposition becomes stronger, because, gentlemen, the courts are holding that there must be compensation where property is taken or injury done thereto.

That being said on the question of legislation another thing comes, and that is taxation. I am not in favor of the single tax. General taxation laws are usually fair, and there is no reason why, under existing taxation laws, a fair valuation can not be placed upon telephone property. The independent telephone people have one thing to learn. Many of them go upon the theory that their property ought to be placed upon a valuation of about sixty per cent of its cost. Where properties have been recently acquired, the depreciation has been slight, and it is an easy matter to determine what the property cost — there has been no fluctuation in values — therefore they go on the duplicate for about sixty per cent of their cost. This method is three or four times as much in proportion as railroad properties are on the tax duplicate for in the same county. It is three or four times as much in proportion as street railway and electric light properties are placed on the tax duplicate for. While they (independent telephone properties) are not on the tax duplicate as a rule for more than the Bell properties, and while we are not asking to be valued lower than the Bell Company's properties, yet there is no reason why corporations of this kind should be taxed on a larger percentage of their

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values than other properties referred to; and this is especially true of telephone companies, in view of the fact that they have so materially reduced the rates and afford so much better and more comprehensive service. This, however, is a thing that can not be taken up by concerted legislation. Nearly all of our States have a commission who fix the valuation of such properties. Some steps should be taken to confer with that commission and arrive at a basis of valuation which is fair, and I think in almost every instance you will find they are willing to do that.

On the question of litigation: A general statement of telephone litigation has been made in the papers recently read here and it has been referred to in the discussion during this convention. I might say more plainly than has heretofore been said that the suit brought by the American Bell Telephone Company against the National Telephone Company, of Boston, involving the validity of the Berliner patent, would have been lost for the lack of proof and preparation, had it not been for the efforts of the Independent Telephone Association of the United States. In the address of the president yesterday some names were mentioned in giving history in regard to this matter, and while I do not want to be understood as meaning that the president's statement needs vouching for, I have personal knowledge of the correctness thereof. First, money was raised, counsel employed, depositions were taken from one end of the country to the other, enormous expenditures were made in that regard; the work was supervised and directed by our worthy president, and but for those persons mentioned by the president yesterday and other unnamed heroes standing with this association, it would have been impossible to carry on this work. Many of the manufacturers are entitled to credit in this direction, but the thing that brought them together and made it possible to work in unison in that matter, was the Independent Telephone Association thru its officers and advisory board. Many say, "What is the use of being a member of this association?" One gentleman here said, "I want to become a member of this association, but some of our people don't want to become members. It will cost the company $10 membership fee and $15 or $25 additional. What reason can I give to my company for becoming a member of this association — for incurring this expense?" The general proposition that it would have been impossible to get thruout this entire land as many men in the independent telephone business as there are sitting in this hall this morning if it had not been for the efforts directed in this regard is sufficient answer to this question. And the further objection has been made that the money that was sought to be raised was for the purpose of providing good salaries for certain gentlemen who were interested in pushing this matter. I want to say to you that not one single solitary dollar of salary has ever been paid to any officer of this association, except to one man one year, a treasurer of this organization, who came from the South, and kept his salary out and let the expense accounts go. Not one dollar of salary has been paid — not one dollar of salary is charged up against this association. Officers of the association, members of the advisory board and friends of the association have gone out and done this work, notwithstanding the fact that at the same time they were charged with impure motives. That is a fact, and those gentlemen who made such charges have met the fate — I say it not unkindly, because I pity them — have met the fate of all men who try to climb by pulling others down, repudiated by honest men or buried in oblivion.

This work is not completed yet, new work is to be done, or rather the same lines are to be further pursued. I am not asking for money. You gentlemen who are here, so far as I know, are all members of this organization. If you are not and are not contributing your fair proportion or will not after your understanding of the matter, you are acting differently than you would in your private business affairs or social matters. If you were going out in the

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evening to dinner and after that to the theater and after that to a little lunch, and do this day after day and week after week, you would divide that expense up. There is not one of you who would be willing to put it all on the willing horse. Now I think you are all doing the other thing. If you are not, see if you are not in the position I suggest, and see, gentlemen, if you would not go into a social matter in this other way, and it is the same thing. But the principal thing I want to suggest in this regard is this: When you meet others — not members, but who ought to be—see if you can not induce them to see the error of their ways. It is a very small matter; it has been said time and time again that 2 cents per telephone was too much to pay as dues. If every one of the telephones and every one of the miles of pole lines used for toll purposes would pay 2 cents and would send it to the treasurer, and not compel the secretary to spend one half to get the other half, it would be sufficient to pay the expenses of the association; but they do not do it. It is a rule in organizations of all kinds that a few have to bear the burdens. It is a rule that always will prevail and which has prevailed in this case, but it excuses no one from contributing his mite. Never lose sight of the main proposition before stated, which is so big that, as the sun, you lose consciousness of its location, you simply know that it is light. The fact that your very life today depends upon what has already been done by the Independent Telephone Association ought to entitle the organization, without personality, to your everlasting gratitude. Where would you gentlemen have been who have gone into the telephone business in the last three years if somebody had not assured you that all would be well in the suit that was commenced in 1895? You had a comfortable feeling that the National Telephone Association had taken up the defense of the Berliner case and you felt way down in your heart that you would be taken care of. Push the association along.

Just one thing further and I have done, and that is the plan spoken of in Mr. Fisher's paper, which has been adopted by the Bell licensee companies in many instances. It has been said that the condition on which Mr. Fish accepted the presidency of the American Telephone & Telegraph Company was that the policy of the company should be so changed that connection might be made between the Bell companies and independent properties where the independent companies had the best of the situation. Now that seems to be the thing that we all thought would ultimately come, and the wonder to us is that it did not come long ago; but the Bell people, in this instance, have done what, in my judgment, they do in all instances. Give them enough rope and let them alone long enough and they will do wrong or will fail to do that which is right within the right time. I do not want to underestimate the strength of the position. I want to impress upon you that it is a good deal hotter now; that it is in better shape to give us "a run for our money" now than it has ever been before; but we are in shape to get our money's worth. But it is yet unfinished; we have yet to be vigilant and watchful.

Legislation and litigation; I might refer to one thing in Indiana, where our secretary, Mr. Daugherty and other good Hoosiers live. The Bell Company, owing to local influence, could not get franchises in many of the places where independent companies had established plants. They went to the legislature and under cover of a very specious title, sought to have a bill passed giving them a franchise in all towns and villages in Indiana having less than 15,000 population. Through vigilance, business sense and acquaintance with politics, "The gentleman from Indiana" (and I believe I am not doing a wrong if I give full credit to Hugh Daugherty) found out what was going on and sent word out to the boys to kill the bill, and it was killed.

All you have got to do, gentlemen, is to stand together, we can always count on some fellow finding out what is going on, and it will not take long to prevent it. No injurious legislation can be passed in any one of half of these

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United States if the independent telephone people unite in opposing it. I believe we do not need much affirmative legislation, but we must see that we are not legislated against, and we must look with scrutiny upon all bills introduced into the several legislatures. Some one in each State ought to be charged with the duty of inspecting all measures introduced, examining them with a view of the possible effect on telephone business, and if they are undesirable, pass the word down the line. We must stand together. You have men in every independent telephone company who are closely identified with the political and business affairs and who stand high in the community's regard. These men organized; these men in touch with each other thruout any county, State or nation, can accomplish all that is necessary to accomplish if their action is uniform and intelligent. Let us stand together all the time. If the policy advocated by the Bell management should ever be pushed, let us say as we have said in the past, let us do as we have done in the past — whip them, and after they are whipped, make terms; and when terms are made, make terms for all, and the man who sells out, not only his property but his friends, after standing shoulder to shoulder in this sort of a controversy, is unworthy the confidence we have placed in him by admitting him to our friendship. There is no occasion for any individual to quit, there is no reason why any new policy need be feared if we but do our duty. The last statement made by the president of the allied Bell companies shows that they have less than 1,000,000 telephones in this country after twenty-seven years. The best information that can be gotten is that the independents, beginning in 1895, have got more than a million and a half of telephones, and each year has showed more and more and more telephones installed than were installed the year next preceding. There is no reason why the more than fifty thousand stockholders in independent telephone companies of this country, standing together, can not dictate the telephone situation. Is there any reason why they can not? They never asked for anything unfair, they do not intend to ask anything unfair, but they want a fair show, and they intend to have it.

I thank you.

DISCUSSION ON BELL METHODS.

BY E. B. FISHER.

I do not expect to have to say anything new or royal. Most of you already know what I shall say this morning. You have had experiences and observations similar to those mentioned; but to recall them may induce the presentation of others and recall new experiences, which may prove an encouragement or a suggestion to those just entering, or about to enter, the independent telephone field.

The man or corporation that should ignore competitors, that fails to study their mutual conditions and profit from them, could not expect to succeed in competitive enterprise and effort. The man or corporation that maliciously or falsely discusses the competitor and its business in the hope that thereby its own business may be benefited makes a grievous mistake, and in the end loses more than is expected to be gained. With these two thoughts as premises, I enter upon a discussion of Bell methods. I could not, under any circumstances, consider such topics in the spirit of criticism only, and were I expected to do so would certainly decline the assignment. The gentlemen who have been conducting the business in the various constituents that we know as the Bell Company are our neighbors and friends. Many of them have been in the telephone business for years, some for quite twenty years. They have extended experiences; they are competent, successful business men, and we can learn much by observing their methods, and undoubtedly can find many examples in their conduct of business from which to profit.

One of the most serious criticisms I have had occasion to suggest as to independent telephone companies is their lack of system, their lack of carefully analyzing conditions and experiences and making systematic deductions there-

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from. They have engaged in the telephone business in too many cases much as the original Bell corporation did, and have been learning from personal experiences rather than from profitable observation of what has already been "thrashed out" in the evolution of the Bell system. It is highly essential, now that the independent systems are becoming larger, more complex and intimately related with each other, that thoro states shall obtain; that first-class construction shall be the rule rather than the exception; that uniformity of practice in the manner of toll service and in the division of revenues arising therefrom shall obtain; that those conducting the business shall exchange experiences, thus enabling all to learn of mistakes and to avoid them, and to secure the advantages of improvements that may be devised. The exchanges of the Bell Company thruout the country have for years enjoyed this interchange of opinion and experience and thru the manifest advantages of such interchange have avoided many difficulties and secured many betterments. We can and should copy this feature. We should meet each other frequently, individually and collectively; should keep in touch with each other by correspondence as well as over the wire. When we hear of a good thing, let our neighbors know of it; when we discover perils or uncomfortable conditions, wire our friends. The Bell, in a sense, altho composed of many subordinate companies, have been one family. We can retain our individuality, maintain our ambition to be the first in our chosen sphere of action, and still remember that we are a part of a family. Some have been inclined to suggest that our friends of the Bell Company have too much system. As the business develops it begins to appear that too much system is less expensive and less foolish than too little. If the managers and operators of independent plants shall more carefully and fully analyze the cost of conducting the business in the different departments and the results therefrom, many errors will be avoided and the ledger balance on the right side will unquestionably grow.

In system business, we have much to learn from Bell methods; we should gain this knowledge and improve on it.

There are directions, as we believe, in which our neighbors are still in error. What shall be said this morning — the statements or conclusions derived therefrom, should be received as they are intended, wholly in the nature of suggestion and warning for ourselves, rather than of criticism of, or fault-finding with the aforesaid neighbors. It is undoubtedly true that the conduct of a monopoly often results in somewhat of arrogance on the part of those who are at the head of it or who hold responsible positions in the management of its business. Such people naturally come to feel that they can do about as they please, and if patrons of the public are not delighted therewith, what odds? I have heard gentlemen who are listeners to this paper more than once offer this suggestion that they would not care for the service of certain Bell employes who had applied for positions, because they were too "cranky." We can see for ourselves how natural it was that crankiness grew upon any officials and managers of Bell plants. They were not obliged to consult the wishes or desires of the public to secure their business and profits. One would take telephone service on their terms or let it alone; that was all there was to it.

This spirit of crankiness, so natural under the circumstances which engendered it, is the exponent of natural conditions which produce other peculiar manifestations often noted and passed for years. We should carefully consider these manifestations which are intended or expected to affect our own business, and by interchange of observations, or experience, help each other and counsel or warn those who are about to engage in independent telephone business. I well remember when, a little more than six years ago, we began canvassing in Grand Rapids, Michigan, to secure the money with which to build the plant of the Citizens' Company, and for patrons thereof, the many stories which were afloat among the people as to our business. It was confidently asserted by representatives of the Bell

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Company in our city and State that we never would build a telephone plant — indeed, that we had no intention of so doing, and were only trying to make money by being bought out. We were in effect, it was intimated, intending blackmail. It was said that we could not build; could not get material; could not properly combine the material when we got it; could not find apparatus that was not infringing; could not get a switchboard that would work; would not know enough about poles to string wire thereon and make them stand up. Even after we had actually begun to install telephones those who had given us contracts were prompted to bet that we would never give service. There were infringement suits which may have been expected to put a stop to our enterprise, but not any of them succeeded — it scarcely seems possible that some of them could have been expected to.

We have been giving service for more than five years and the company, which was then organized with but $100,000 authorized capital, has grown until it has today in service more than one-half as many telephones as the Bell had in the entire State of Michigan five years ago, and has an authorized capital well toward one-half of what the Michigan company then had. And yet today similar predictions upon like enterprises, even in Michigan as well as in other States, are indulged in by our neighbors. Officials of the Erie Company have informed the public thru the press within a few weeks that the new independent plant will never be built in Detroit; that the People's Company in that city will never give service. When, in your respective localities, the Bell resorts to such methods to dissuade the public from patronizing you, to persuade them that you are not intending genuine business, you can comfort yourself with the fact that you are not singular in this experience, and you can point to results in other localities, and say to your friends, "It is an old story, and no truer here than it has been elsewhere."

If you get started with service and you find that you receive circular letters that the Bell is owner of letters patent "steen hundred thousand and steen," and that all who own the independent apparatus infringe such letters patent and are liable to prosecution for using the same, do not flatter yourself that in this method the Bell Company is distinguishing you beyond other independent companies. Such things have been done repeatedly. You have yet to hear of a subscriber who has been so prosecuted, and you can very easily guarantee your patrons against any damage that may be started by any court under such suit, and that you will pay all costs for defense. If you should find that the Bell Company, which has frequently informed the people in your community that their former rates were the lowest that they could afford to make for their service in your community has, as a result of the development of your competition, resorted to free service, or much less than cost rates in an effort to destroy you, do not be fearful that such practice can really damage your company. Do not imagine that you are enduring an experience novel in the telephone business. Do not, for a minute, when the Bell resorts to this method, attempt to meet competition by establishing like rates or lower rates for your own service. Begin the education of your people; take them into your confidence; tell them the truth about your business and the results; insist upon a fair profit, upon reasonable returns on the actual investment after giving good service, and you will find the people ready to pay your price rather than to get absolutely free service from the competitor. Do not resort to other actions, because there can be but one result from such procedure. The Bell method is a "war measure" pure and simple, and if it could succeed, would be followed by such advance in rates as would fully compensate that company for the temporary concession of free service or less than cost rates. This fact has to be but stated to intelligent business men to be apparent to them, and to influence their actions. This method, which has been practiced by the Bell subordinate companies in considerable regions of the country, so far

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as I know has not succeeded in taking away the patronage of an independent company honestly striving to give good service at a reasonable rate. The company that reduces its rates below a reasonable point in the struggle with the Bell Company is doomed the moment it does so.

What do you think of party-line service? One of the methods of the Bell Company in its efforts to meet the lower rates of independent telephone companies has been to introduce and unite largely party-line service, with important reductions in rates for such service. Has it been successful where you have observed it? Is it a serious menace to a competitor? Of course we know that the new president of the Central Union and the Chicago telephone companies, who will still retain his position at the head of the Pacific Coast company — all Bell — is a stanch advocate of this sort of service. He is a gentleman of extended experience and wide observation in telephony, and for that reason his opinion is not to be lightly dismissed or treated with indifference. We are this morning discussing Bell methods in the hope that we may learn from them and profit from either accepting or avoiding their example. My own observation has been that party-line service is largely "a snare and a delusion" where given in city exchanges, and is not a competition that we need fear. It is evident that no device has yet been invented which will enable more than two parties to use the line at the same time; so when any pair on a party-line holds the line others must wait. Should this sort of service be generally used, the difficulty of securing your own line and of getting connection with other parties on similar lines is manifestly very greatly increased. We all know how impatient the average telephone user is to get service the moment it is wished. You have known subscribers ready to swear that the girl kept them waiting twenty minutes for a connection when it should not exceed twenty seconds. I do not believe that you will be compelled to resort to party-line service to meet this method of the Bell competition. The B. W. O. service which was expected to work wonders three or four years ago is not very generally popular.

No discussion of recent Bell methods would be useful if we did not consider minute rates for toll service. What is your observation on this topic? The high authority from the Pacific Coast, who is trying to stifle competitors in the Central Union territory, and to prevent it in Chicago, who is indeed regarded as the possible head of the American Telephone & Telegraph Company, is the father of the minute-rate service. He sets great store by his scheme and has assured its adoption in considerable territory outside of that which he controls. We, in the Michigan territory, find it one of our competitions and have not quite made up our minds as to its present and probable effects. However, on general terms, it is fair to state that it is causing considerable friction and dissatisfaction. The average telephone user is ready to affirm that he has not used the service as long as he has been charged for. He considers himself a victim of overcharge. He believes that the minute rate is intended to thus increase the fees of the telephone company, which he was inclined to believe are already quite large enough. If the average business man, on a long-distance connection, can actually accomplish his conversation in a single minute, it strikes me that at the price for one minute connection the line can not earn enough; for we all know that quite as much time as heretofore has been spent in getting two parties to talking as is occupied with their conversation. Now, if the time for securing connections can not be reduced and the time of using is reduced, with theoretical reduction of pay, service will be less profitable to the companies on the three or five minute basis. If the average subscriber is expected to use the line on the three or five minute basis why not take rates upon that theory? That would be fair to both company and patron. It would secure the desired revenue even if but one minute should be actually used. The purpose of this paper, as before indicated, is to set you to talking about your mutual expe-

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riences and to induce discussion rather than to state conclusions.

In Michigan our neighbors have taken a new departure within the last few weeks. Formerly they refused to admit that any other apparatus than the Bell could be successfully used in telephone service. The subcompanies of the great company were supposed to have a hard and fast contract forbidding the use of any other apparatus and forbidding any connection with any other apparatus. Latterly the Michigan Telephone Company has been attempting to secure, in a few instances, toll-line alliances with companies formerly built and still continued, as far as exchanges are concerned, as independent companies. The Michigan company has said in effect to such companies, keep your local exchanges, even your own toll lines; take control of your exchange business in your locality, but enter into a contract for toll connections outside your territory thru the Bell system; it will give you equal percentages on originating business to that you have heretofore enjoyed and provide you with more extended and superior toll-line facilities. This late Bell method is insidious, and it is not strange that in some cases it is successful. Where such a contract is made exclusive, and of course they try to make it exclusive if possible, it subtracts by so much from the efficiency of adjoining neighboring independent service. So anxious has the Michigan Telephone Company become in this matter that I believe it is true it has been willing to make arrangements in some cases for a divided toll service, where it was impossible to secure an exclusive contract. This Bell method is one of the most threatening efforts ever made, and yet has its silver lining. The strong independent companies have not been influenced by such propositions; only the smaller and weaker companies have made such contracts with the Bell Company. Of course, no independent company has been willing to parallel the lines of any other independent company, no matter how inferior might that neighboring plant be or how imperfect its service. Now that sort of territory will be provided with up-to-date independent plants. This recent manifestation would seem to indicate that the parent company must have consented to abandonment of the exclusive feature of its contracts with subordinate companies.

I believe that the Bell habit of ignoring the farmers, the small villages and the country, has been an error. I think that in this department of telephone service a proper development of party lines may be made with great advantage to the communities served and with fair profit to the investor. There are regions in Michigan, and probably many of you could repeat the same tale where the Bell is beginning to compete with independents in their own field in this regard. I say their own field, because the independents were the first to deliberately provide this sort of service. This Bell method of following a good example may prove a formidable competition and may materially strengthen their smaller exchanges and their situation if they shall first enter new business with this sort of service.

There was a time when I think it was actually believed by the average general manager or prominent official connected with the Bell Company that an independent company could not possibly secure intelligent, experienced employes. They thought that we would be compelled to go thru the process of evolution which was so tedious and costly in the earlier days of the Bell Company; that their employes would remain with them. They even thought that, in some localities, an independent company could not get exchange operators, and in some instances, employed superfluous help simply to keep them from entering the service of independent competitors. Some know more today of this topic than they did a few years ago. A large number of the brightest men in telephony have found employment in the independent fields, and there is scarcely one in this convention hall who has not had frequent opportunity to secure many more of the most important employes of the Bell Company than he had places for. We have been surprised at times at the

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seeming lack of loyalty to their employers by those who have been so long on the Bell pay-rolls. Perhaps a little analysis of Bell methods may explain the situation and furnish a warning for ourselves. The rewards among the Bell employes heretofore have not been great, either in salaries or opportunities. They have been made to feel more like mechanics than human beings. In many cases they have not had their inventive tendencies encouraged by proper compensation for what they produced. Indeed, they have been compelled to part with their inventions on the theory that the brains as well as the labor belong to the employer, or because there was but one market for their invention and devices. This treatment is not conducive to loyalty or to inducing energetic service. The independents, if they shall copy Bell methods in this respect, will make a grievous mistake.

If you should wake up some fine morning and hear that you have sold or are about to sell your telephone plant to the Bell Company, do not consider that the transaction is necessarily closed. If you hear similar reports as to actual or impending sales of other independent companies in your own or other States, be not disturbed thereat nor convinced that the news is reliable. There have been some such sales, but vastly many more rumors of those that never have occurred and do not seem likely to. There have been methods in these rumors, for some reason, some interest — evidently not independent — has believed it desirable to circulate such reports, probably in the hope that other independent interests might be disquieted or discouraged and yield more readily to apparently more advantageous offers. These methods have been relied upon to produce serious effects. Keep yourself and your neighbors advised of the strength and growth of the independent movement, of the strength of their own situation in competition, and fewer such rumors will be verified hereafter.

In nothing that I have said thus far have I given any of you real news. As I said to one of my friends, I felt that it was impossible to do so and was almost ashamed for having tried to prepare and read such a paper; but if it shall refresh your memory, if it shall induce you to give experiences and observations of your own, if it shall attract, thru publication in our annual reports or otherwise, the attention of any who are about to engage in telephone business, and shall hearten and strengthen them in their enterprise and efforts, it may accomplish some of the good earnestly desired and intended in the preparation of the paper. As stated at the outset, it is not in criticism or derogation of the Bell Company that it is offered; that corporation has the right to resort to any efforts within the bounds of facts it may choose to make, and we have equal rights to discuss its methods and by considering them, minimize their effects, if not entirely overcome them. It is in this spirit of consideration only that this paper is offered.

EXCHANGE SERVICE.

BY L. W. STANTON.

This subject may be divided into three important branches: Reliability, promptness, good transmission. Any of these, if not up to its highest state of perfection, mars the general result.

The first of these, we all know, is of the utmost importance, for the business man of today will not for a moment tolerate unreliable service.

The second, promptness, is an essential quality of popular service. There is nothing more annoying to the modern business man than slow service. When he steps to the telephone, he expects an immediate reply, and if he is compelled to wait even for a short time he becomes dissatisfied with the service.

For good transmission as well as apparatus we must depend upon the reliable manufacturer. The independent telephone interests are today in greater danger on account of some of the inferior apparatus that is being thrown upon the market than they have ever been from the old monopoly. Some of the apparatus that is being sold today by the independent manufacturers is a curse to independent telephony. It

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only half works. It is unreliable, it does not give good local service, not to mention the poor results obtained when used for long-distance lines. Every telephone that is installed today should be one over which conversations between New York and Chicago can be carried without difficulty, for it is only a matter of a short time till every telephone in this broad land will be connected by a network of long-distance lines to every city, village, town and hamlet. The continued use of inferior apparatus will mean unreliable service, poor transmission, expensive maintenance and a final discarding of the original installation at a great loss, and worst of all, dissatisfied subscribers. I feel sorry for the independent interests when I see this inferior apparatus being installed in exchanges that are being newly equipped, for it means a loss of prestige. It is true it is difficult for the independent telephone companies to select the best apparatus, for, as a rule, their experience has been limited to the use of apparatus that was a few years ago.

Another reason is the unparalleled strides that have been made in telephone manufacturing within the last few years. They have been accustomed to the old magneto drop board, which is undoubtedly a thing of the past in exchanges of any size. It is the opinion of the writer that in any exchange of over one hundred subscribers, where suitable arrangements can be made for current, the only thing to install is a central energy lamp signal board with double supervision. This style of board saves an operator a great many moves, such as restoring line signals, and cutting in on subscriber's line to inquire if party answered, or if they are thru talking, for with double supervision she can tell at a glance whether the called-for party has answered, or if the conversation is finished.

Wherever an exchange requires three or more operators a multiple board should be installed, for when transfers are used they impede the service and add permanent expense to the operating. On a large transfer board you almost double your work, for nearly every call has to be trunked to a second operator, while with a multiple board each operator handles her subscribers' calls direct, without assistance. Another distinct advantage of the multiple board is, one operator in the evening and on Sundays can sit at one position and answer all calls thru the multiple. In this way, with double supervision, she has control of the entire board.

I do not doubt that some of you are of a different opinion, but I will endeavor to show why this class of apparatus is superior.

It gives better service.

It is cheaper to operate: First, because it requires fewer operators; second, because it dispenses with hundreds of local batteries scattered over miles of territory; third, it does away with an expensive piece of mechanism — the generator, with its cog-gears, shunts, commutators, etc., which have a constant source of wear and tear; fourth, in eliminating the generator and batteries the number of inspectors can be reduced, which is no small item.

The following will give you some idea of the saving in the cost of current for an exchange of 1,000 subscribers. Taking the cheapest form of battery, which is the dry cell, at 15 cents each, and using two cells per 'phone, which is modern practice, it gives a cost of 30 cents per 'phone. Allowing the battery a life of one year, which is more than the average, we have a cost of $300 per year, or $25 per month for the 1,000 'phones.

In one of our central energy exchanges of something over one thousand subscribers I find the average cost of all current for operating line signals, supervisory signals, and all current used for talking, amounts to approximately $6.50 per month, which is about one-fourth of the cost for current for operating the same size system with local batteries, to say nothing of the additional cost of labor for renewal and maintenance.

From a number of monthly reports of trouble covering both common battery and magneto type exchanges, I find that the number of cases of trouble at the subscriber's instrument is from two to four times as great for local as it

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is for common battery plants. With one of the latest types of central energy telephones the trouble at the subscriber's station is reduced to a minimum. There is practically nothing left but the transmitter, receiver and signal bells, and these as they are made today by some of our best manufacturers almost eliminate the possibility of trouble. This, coupled with accurate and scientifically constructed apparatus at the central office, gives the ideal system, and it is only with an ideal system we can give ideal service. It is often remarked that it requires better line construction for common battery plants, which is true to a certain extent; but any good line will work well with the common battery, and in some cases this system is worked on a common return.

Telephone men are beginning to realize the importance of good line construction, especially when they see the great difference in the expense of maintenance between well and poorly constructed lines. The Bell Telephone Company's plant in St. Louis, in whose employ the writer spent several months in different departments, during the building of their new common battery exchange, offers an example of first-class construction. In building this exchange they were extremely particular that every detail be carried out in the best possible manner. It seemed at the time that it was a waste of money, but I have since realized that it was money well invested. The entire system was put in so that it would stand the test of time. The interior wiring was protected in every possible way; 'phones were placed on the wall in the most substantial manner; cable work and line construction was unequaled. As a result the number of cases of trouble per 'phone is less than that of any other telephone exchange in the country. The American Bell Company, of Boston, have awarded them the credit of giving better service than that given by any other licensee company, and in the face of the strongest competition, I understand their financial showing is very good, which would not be possible with slighted details and poor construction.

The telephone business stands today on a higher plane than ever before. The independent movement has forced the Bell companies to put forth their best efforts, and this in turn has stimulated the independent companies, but telephony is yet far from its ideal goal. Look thru the operating rooms of some of the large Bell and independent companies and notice the number of idle operators, while on the same boards there are operators that have more calls than they can properly handle. Few telephone men seem to have realized the importance of equalizing the load among the operators, that is, placing enough lines in front of each operator to properly load each position. The accompanying charts, giving the peg-count curves, will convey the meaning more readily and show where thousands of dollars can be saved in the cost of operating, by reducing the force besides giving more efficient service.

In chart No. 1 we have the load curves showing the number of calls answered by each operator. Figs. 1, 2, 3, etc., along the horizontal line at the top of the chart, designate the operator's position. The figures in the vertical column at the left designate the number of calls answered in twenty-four hours. The heavy black line, where it crosses the operator's position line, designates the number of calls for that operator's position for twenty-four hours. For example; the heavy black line, or index line, crosses the line representing position No. 1 at approximately 1,040, which is the number of calls answered at that position during twenty-four hours; position No. 2 answered, during twenty-four hours, 1,000 calls; position No. 3, 910 calls; position No. 4, 1,343 calls, etc.

The chart (Fig. 1) is not imaginary, but one accurately compiled from an exchange of 1,563 subscribers, and the number of calls is slightly over 17,000 in twenty-four hours, which gives an average of ten and a fraction calls per 'phone. While this exchange is being operated by twenty-five operators, they are not giving as prompt and efficient service, on a whole, as would be obtained by eight or nine operators with a switchboard properly designed, and

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the board equalized by means of an intermediate, cross-connecting board. By the use of an intermediate board in connection with a multiple switchboard and subscriber's line signal and answering jack can be shifted in front of any operator, without changing the subscriber's telephone number. In this manner the busy lines, which are generally located in front of the first few operators, may be shifted in part to one of the operators who has mostly residence 'phones, and in turn some of the

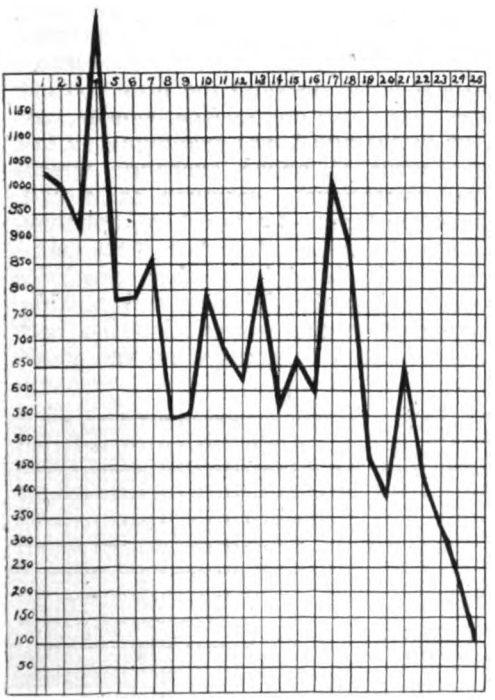

FIG. 1.

residence 'phones should be shifted in front of the operator who has all business 'phones. In this way each operator may be given approximately the same number of calls for the twenty-four hours, which should be practically 2,000. This would mean that during the busiest hour she would answer approximately 250 calls.

It has been found thru hundreds of tests, that one-eighth of the number of calls answered during twenty-four hours is approximately the number answered during the busiest hour. Two thousand for twenty-four hours, 250 of which are answered during the busiest hour, is not excessive for any ordinary operator; in fact, there are many operators who are handling busy positions that are answering considerably in excess of this number. In one case, the writer knew of an operator answering 528 calls an hour, and in another case of a trunking operator handling 1,248 calls per hour. This is excessive, and can not be continued but a short time, but an operator answering from 200 to 250 calls per hour on a modern switchboard is not excessively busy, and with good team work among operators, they can give better than four-second service. Operators without exception prefer the busy positions, and the operators who answer the fewest calls are invariably the ones who give slow service.

Chart No. 2 shows the necessity of distributing the business and residence 'phones in front of the operators. In this chart, the vertical column shows the number of calls answered per hour, and the horizontal heading at the top shows the different boards. A board has all business 'phones, while B, C and D boards have about the same number of each business and residence 'phones, while E board has all residence and farmer line 'phones. Index line No. 1 designates the number of calls answered by each operator during the hour from eight to nine in the morning. The operator on A board answered 120 during this hour, while the operator on E board answered approximately half this number. Index line No. 2 shows the number of calls answered from eleven to twelve A.M. and during this hour the A operator has answered about half what the E operator answered. This you will notice is a complete reversal of what it was during the hour ~~from eight~~ to ~~nine~~, or in other words, one operator is idle while the other is busy and vice versa.

In this exchange, with a proper switchboard, and the load equally distributed, two operators could answer all the calls, and give A No. 1 service.

From scores of peg counts taken among the independent telephone companies, I find ten and a fraction calls per 'phone to be the average. Taking

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these figures as a basis, it will require 200 subscribers per operator to give an average of 2,000 calls for each position

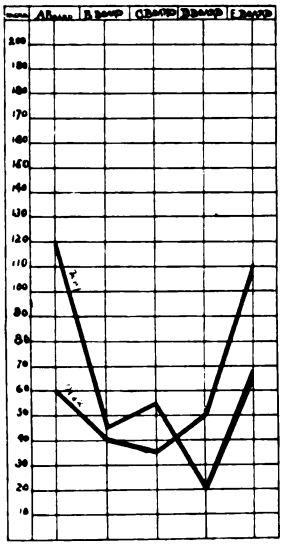

FIG. 2.

for twenty-four hours. This number would be excessive if they were party lines with four or six parties on a line, or if they were all business lines like we find in some downtown branch offices, which have no residence 'phones to reduce the average number of calls per 'phone; or in an exchange where a large per cent of the calls have to be trunked to another exchange, in which case the trunking consumes more of the operator's time than is required where connections are made direct in the multiple.

Chart No. 3 shows the number of calls answered per hour for twenty-four hours.

A chart similar to any one of the three can be easily made after taking a count of the number of calls answered by each operator, during each of the twenty-four hours. The calls may be tallied with a pencil and paper, or by moving a peg from one jack to another, or best of all, by using the tally register made by James O. Benton, of 8 Abingdon square, New York.

The operating force of a large exchange is one of its most important factors. If the operators are well disciplined and courteous, the subscribers are quick to notice and show their appreciation. Even a second or two is noticeable to a subscriber when awaiting an answer from central, and on hearing the operator call "number" in a brisk, clear tone, with a rising inflection, it conveys the idea of discipline; but if the operator answers with a falling inflection and uncertain voice it gives the opposite impression. In fact, the operating force is nearer to the telephone public and wields a greater influence among the telephone users than any other class of individuals connected with the company. It is thru the operators that we dispense the little courtesies that make our service popular. A few weeks ago I was examining an independent telephone exchange which was exceptional, inasmuch as it had over one hundred subscribers, but thru the carelessness and neglect of the manager (who lived in another town) in maintaining the 'phones and outside construction the subscription list had been reduced to twenty-five, and those

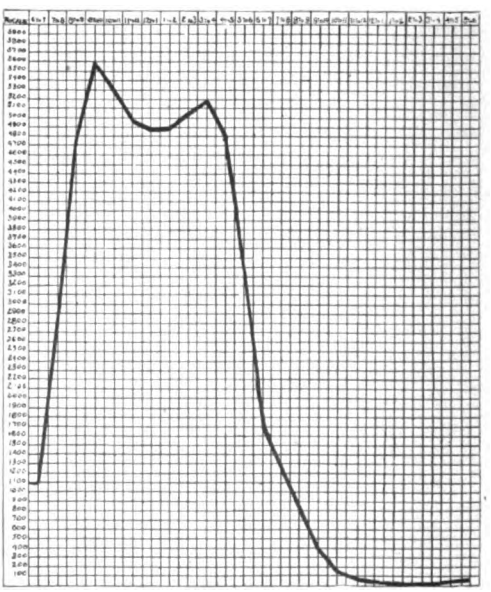

FIG. 3.

twenty-five, I am told, remained on account of the courteous treatment they received from the operator, who was

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certainly exceedingly kind and obliging to the subscribers. On the same day I visited this exchange I was in another small city, and while talking over the telephone situation with one of the citizens there he assured me that the chief operator of the Bell Company at that place had done more than any other twenty causes combined to make the Bell Company unpopular. These two cases just cited certainly show the importance of courteous operators. I remember an instance where I reprimanded an operator who had formerly been with the Bell Company for speaking cross to a subscriber. Her answer was, "Why, Mr. Stanton, you ought to hear how cross the Bell operators are, and you would not think we were cross."

I prefer not to employ Bell operators. As a general thing they have some undesirable traits which become more prominent when they try to show their importance to the "new company," as they term it. There is always an army of applicants besieging a telephone company for employment, and if you are any judge of human nature you will not be long in choosing a list of girls, and with proper training and appreciation of their efforts will make a very efficient corps of operators. There are few managers who realize the great advantage derived from the proper training of their operators. As a general thing an operator, after being employed, is given a seat at the switchboard beside one of the old operators and is told to watch the other operators and learn what she can, and in a short time she commences to answer a few calls, and from that time on she is supposed to be an operator. As a matter of fact she is far from being one. She should become thoroly familiar with all the rules and should have their meaning explained to her. She should be taught how to handle the plugs with the left hand as well as the right. Until she can use her left hand as easily and naturally as her right she is only half an operator. She should be taught how to answer two and three calls at the same time without interference. It is only in this way that an operator can answer quickly and handle the number of calls that she should. Walk thru almost any operating room, especially that of an independent exchange, and notice the number of wooden arms and mallets that are in use; notice the number of false moves and untrained voices; and you will realize that the company is spending unnecessary money. By wooden arms, I mean that the operators do not use the left arm any more than if it was wooden; by mallets, I mean that they are driving the plugs in by the heel of the hand, breaking the tinsel of the cords, causing a cut-out, which means unsatisfactory service, besides the expense of replacing the broken cords. By false motions I mean that the plug is picked up with one hand and passed to the other instead of being inserted with the hand with which it is picked up. These are only a few points in which the operators should be trained.

The operating room should be conducted on a merit basis and promotions made according to the efficiency and courtesy of the operators. During each month competitive tests should be made to determine the speed and courtesy of operators in answering subscribers, and those having the highest general average as regards speed in responding to calls, courteous treatment of subscribers, obedience to rules, promptness in reporting for duty and regularity of attendance, etc., should receive some sort of promotion. Those who thru these tests prove to be unqualified for the position of operator should be discharged. A form of promotion which I have found to work well is to give the operator having the highest general average the most desirable hours, and those least efficient the night hours. Another reward of merit which works well is to recognize an operator's ability by giving her a small raise in wages. I do not believe in giving an operator a large raise in wages at one time, but to encourage them and to show that their efforts are appreciated by giving them an increase of, say, $1 at a time. This may seem like a small amount, but a girl will appreciate this raise as much as a man

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would an increase of $5 or $10, and by giving a small raise at each time you can reward their efforts more frequently and thus get better results. Another method which I find works admirably is to arrange each operator's merit standing, showing which is first, second, third, and so on, leaving a copy in their recreation room. This starts a friendly rivalry among the operators which produces results that can not fail to make our service popular.

Every large operating room should be presided over by an A1 telephone man, who is thoroly acquainted with every detail of the business, and who realizes the necessity of prompt action in the trouble department and the proper disciplining of the operating force. Last but not least, he should have the faculty of dealing with the telephone public. There is no other business that requires such an endless amount of detail and everlasting vigilance. You are serving a criticizing, fault-finding public, who have all whims and fancies imaginable, but who appreciate and are willing to pay for first-class service, and your success is measured by the class of service you give.

ELECTION OF OFFICERS AND UNFINISHED BUSINESS.

A committee consisting of L. A. Frazee, of Indiana, H. D. Critchfield, of Ohio, and C. W. Kline, of Pennsylvania, nominated the following gentlemen as officers of the association for the ensuing year and the secretary cast a unanimous vote for each of the gentlemen:

President, James M. Thomas, Cleveland, Ohio.

First vice-president, H. C. Young, Columbia, Pa.

Second vice-president, C. E. Stinson, Rochester, N. Y.

Third vice-president, W. H. Durin, Cedar Rapids, Iowa.

Secretary and treasurer, S. P. Sheerin. Indianapolis, Ind.

First assistant secretary, J. B. Ware, Detroit, Mich.

Second assistant secretary, C. E. Wilson, Philadelphia, Pa.

Third assistant secretary, J. B. Lee, Pittsburg, Pa.

The executive committee met and elected the advisory board for the ensuing year.

EXECUTIVE COMMITTEE.

Illinois — George W. Fair, Chrisman.

Indiana — L. A. Frazee, Connersville.

Iowa — A. T. Pressen, Iowa City.

Kentucky — J. A. Armstrong, Louisville.

Louisiana — L. H. Lancaster, Thibodaux.

Michigan — J. B. Ware, Detroit.

New Jersey — John J. Burleigh, Camden.

Ohio — Ed L. Barber, Wauseon.

Massachusetts — Vinton A. Sears, Boston.

Pennsylvania — C. W. Kline, Hazleton.

Minnesota — C. H. Judson, Minneapolis.

Texas — Mrs. Anney McElroy Brett, El Paso.

Virginia — R. F. Hogsett.

West Virginia — W. K. Cummings, Wellsburg.

Wisconsin — I. H. Moulton, La Crosse.

ADVISORY BOARD.

James M. Thomas, Cleveland, Ohio.
S. P. Sheerin, Indianapolis, Ind.
Hugh Daugherty, Bluffton, Ind.
H. D. Critchfield, Cleveland, Ohio.
E. B. Fisher, Grand Rapids, Mich.
S. E. Wayland, Wilkesbarre, Pa.
W. B. Seaton, Ashland, Ky.
George W. Beers, Fort Wayne, Ind.

The ninth member of the board to be chosen by the other members, place being vacant on account of Mr. Durin becoming an officer.

Moved by Mr. Hugh Daugherty that the executive officers be requested to print the proceedings for general distribution, and to include an authentic list of the independent telephone companies in the United States.

Motion seconded and carried.

Moved and seconded that the convention express their thanks to the press

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of Buffalo, especially the Buffalo *Courier,* which has been doing a noble work for the independent movement in New York and has been hammering it into the people for the past three months in editorials and everything else.

Motion carried.

Moved and seconded that the convention extend a vote of thanks to the mayor of Buffalo for his presence at the convention and his address, also to the local committee on arrangements for making our visit to Buffalo such a pleasant one, and for the use of this hall.

Motion carried.

Presented by H. D. Critchfield.

RESPONSIBILITY FOR ELECTROLYSIS.

The report of the Master in Chancery on the Peoria electrolysis litigation is given on another page of this issue. The decision is unique in its frankness, and, in so far as it places the entire responsibility for the alleged damage to the mains and services of the Peoria Water Works Company upon the electric railway companies, it establishes a precedent which may be far reaching in its effects upon the capital invested in electric roads thruout the country.

The question of the right of the railway companies to use the earth as a return commenced almost simultaneously with the introduction of the trolley. The telephone companies first raised objections to this owing to the interference with their service, which at that time was almost entirely on grounded circuits. The railway companies were victorious in the resulting litigation and the telephone people were required to introduce metallic circuits as a result. The question involved in the controversy was somewhat different from that due to the Peoria conditions, and it is fair to assume the railways had as much right to the earth as the telephone companies.

Subsequently, however, attention was directed to the apparent deterioration of certain metallic underground structures, such as water pipes and lead-covered cables. After some experimenting it was found that, owing to the poor rail bonds, the rails being used as a return, the railway currents were leaving the rails at points remote from the power stations and following the water mains and lead-covered cables as the path of the least resistance, and, within certain districts adjacent to the power stations, returned to the rails.

These districts may be entitled the "danger districts," for damage is chiefly done when current leaves the mains or cables to return to the rails. Under these conditions the cables become the anode and the rails the cathode of an electrolytic cell, the earth, where moist, acting as the solution in the cell. The rapidity with which the deterioration occurs is largely affected by the difference in voltage between the cables and the rails. The greater the difference in voltage the more rapid becomes the deterioration, and vice versa.

The decision under discussion points to the adoption of the overhead double trolley or a completely insulated metallic circuit as the only means of effectually and completely removing the cause of trouble. Without commenting upon the facts in the matter, it is evident that should the Peoria decision be upheld by the court of final jurisdiction, the effect will be to require the electric traction companies to double at least their present investment in copper.

The decision is more pronounced in view of the fact the master finds from the evidence that the railway in Peoria has a return system which is as good or better than the average used by overhead single-trolley systems in cities of the size of Peoria. It is unquestionably true that many street railway companies are not in a financial condition to double their investment in copper at present or in the near future. While it is important that the street railway managers generally should give more careful attention to the study of the conditions with relation to their respective plants than heretofore, with a view to diminishing or removing the electrolytic effects complained of, rulings which will suddenly and greatly embarrass capital invested in good faith and with the best expert advice available under the state of the art at the time of the investment,

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should be seriously considered before definite penalties are imposed.

The electrolysis difficulties are best met when all parties interested work together harmoniously, with a full understanding of the technical and financial problems involved.

A LABOR AGREEMENT.

Owing to the great amount of independent construction thruout the East, and consequent demand for telephone labor, many Bell companies have been compelled to sign the following articles of agreement to retain the men in their employ.

ARTICLE I. It is mutually agreed between local and company, that eight hours shall constitute a day's work, commencing at 8 A.M. and ending at 5 P.M., with one hour for dinner between 12 and 1 P.M.

ART. II. It is mutually agreed between local and company, that the rate of compensation for one day's labor of eight hours for foreman shall be three dollars and fifty cents ($3.50).

ART. III. It is mutually agreed between local and company that linemen shall receive a compensation for one day's labor of eight hours three dollars ($3.00).

ART. IV. It is mutually agreed between local and company that the term foreman shall mean men in charge of work, irrespective of title, giving orders to linemen.

ART. V. It is mutually agreed between local and company that no foreman or lineman shall be employed less than six days in any one week.

ART. VI. It is mutually agreed between local and company that time and one-half shall be paid for all overtime.

ART. VII. It is mutually agreed between local and company that the term overtime shall mean Sundays, legal and State holidays, and any time between the hours of 5 P.M. and 8 A.M., except (*a*) when men are employed regularly nights as emergency men; (*b*) that when men are employed regularly seven days or seven nights per week.

ART. VIII. It is mutually agreed between local and company that whenever possible to obtain union men they shall have the preference, provided the company has no grievance against individual members of local applying for employment. When impossible to obtain union men, then non-union men may be employed, provided the company guarantees his membership to local two weeks from date of employment, and that the local have no personal grievance against him as an individual.

ART. IX. It is mutually agreed between local and company that this agreement shall supersede all present conditions under which we may be employed.

ART. X. It is mutually agreed between local and company that all traveling between different jobs shall be done on the company's time, except in the following case: When working out of town, traveling on trains or other means of transportation, that one way shall be on the company's time and one way on workman's time, the company to pay car fare both ways.

ART. XI. It is mutually agreed between local and company that no discrimination shall be used against any officer or member of a committee who may be called upon to interview any executive officer of the company.

LONG WIRE SPAN OVER CONNECTICUT RIVER.

The American Telephone & Telegraph Company has erected across the Connecticut River twenty wires for its long-distance telephone service between New York and Boston. The span is 1,300 feet between towers on the two sides of the river. The wires are made of a composition called "phono-electric," possessing a tensile strength of 82,000 pounds per square inch and conductivity of about fifty per cent that of pure copper. In such a case strength is more important than a low resistance. The wires are placed ten on an arm about one foot apart and are insulated by saddle-shaped insulators. It was necessary to string all these wires at equal tension to avoid their crossing in windy weather. To obtain this equal tension each wire is fastened to an iron bolt 5/8 inch in diameter and about 20 inches long.

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THE BERLINER TELEPHONE PATENT DECISION.

CIRCUIT COURT OF THE UNITED STATES, DISTRICT OF MASSACHUSETTS. IN EQUITY.

No. 653.—AMERICAN BELL TELEPHONE COMPANY, COMPLAINANT, *vs.* NATIONAL TELEPHONE MANUFACTURING COMPANY, ET AL., DEFENDANTS.

No. 655.—AMERICAN BELL TELEPHONE COMPANY, COMPLAINANT, *vs.* CENTURY TELEPHONE COMPANY, ET AL., DEFENDANTS.

ATTORNEYS.—Fish, Richardson & Storrow, for American Bell Telephone Company; Edward P. Payson, for National Telephone Manufacturing Company; James E. Maynadier, for Century Telephone Company, et al.; Robert S. Taylor also argued for defendants.

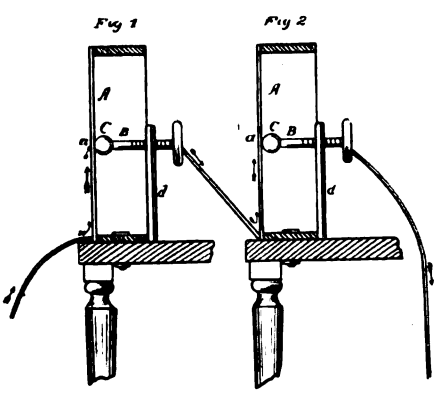
OPINION OF THE COURT, JUNE 24, 1901.

BROWN, *J.* These suits are for infringement of Letters Patent No. 463,569, issued Nov. 17, 1891, to the American Bell Telephone Company as assignee of Emile Berliner. The patent states that the invention consists

"in a new and useful improvement in transmitters for electrically transmitting sound of any kind."

The defendants contend that the patent is invalid and that Claims 1 and 2, on which the complainant relies, are either invalid or so limited in scope as not to include the defendant's devices.

The following drawing is from the patent:



DRAWING FROM BERLINER PATENT.

The invention is thus described in the specification:

"It is a fact that if at a point of contact between two conductors forming part of an electric circuit and carrying an electric current, the pressure between both sides of the contact becomes weakened the current passing becomes less intense — as, for instance, if an operator on a Morse instrument does not press down the key with a certain firmness the sounder at the receiving instrument works much weaker than if the full pressure of the hand had been used. Based on this fact I have constructed a simple apparatus for transmitting sound along a line of an electric current in the following manner:

"In Figs. 1 and 2 of the drawing, A is a metal plate well fastened to the wooden box or frame, but able to vibrate if sound is uttered against it or in the neighborhood of said plate. Against the plate and touching it is the metal ball C, terminating the screw-threaded rod B, which is supported by the bar or stand *d*. The pressure of the ball C against the plate A can be regulated by turning the rod B. The said ball and plate are included in circuit with an electric battery, so that they form electrodes, the current passing from one of them to the other. By making the plate vibrate the pressure at the point of contact *a* becomes weaker or stronger as often as vibrations occur, and the strength of the current is thereby varied accordingly, as already described. By placing now, as is shown in the drawings, one such instrument in the station, Fig. 1, and another instrument capable of acting as a telephonic receiver in the station Fig. 2, both situated on the same electric circuit in which a current is passing (as shown by the wire connections following the arrows), sound uttered against the plate of the instrument Fig. 1 will be reproduced by the plate of the instrument Fig. 2, for as the vibrations of the transmitter Fig. 1 caused by the sound will alternately weaken and strengthen the current as many times as vibrations occur, the diaphragm of the receiver will be caused by these electrical variations to vibrate at the same rate and measure. The latter vibrations being communicated to the surrounding air, the same kind of sound as uttered against the transmitter Fig. 1 will be reproduced at the receiver Fig. 2, or in as many other receiving instruments as are situated within the same electric circuit.

"It is not essential that the plate should be of metal. It can be of any material able to vibrate, if only at the point of contact suitable arrangement is made so that the current passes through that point. The plate may be of any shape or size, or other suitable vibratory media may be used — a wire, for example. Any other metallic point, surface, wire, etc., may be substituted for the ball. There may be more than one point of contact to be affected by the same vibrations. Both of the electrodes may vibrate, although it is preferable that only one should. If the uttered sound is so strong that its vibrations will cause a breaking of the current at the point of contact in the transmitter, then the result at the receiving instrument will be a tone much louder, but not as distinct in regard to articulation."

The drawing shows two distinct instruments. The transmitter, Fig. 1, is the subject-matter of the patent in suit. Its plate is vibrated by sound waves, and the vibrations produce electrical undulations. It is conceded by the complainant that the instrument of the patent is substantially the old Reis structure illustrated in the *Telephone Cases*, 126 U. S., pages 40, 53, 58, 60, 191, 196.

With this apparatus Reis, as early as 1861, transmitted musical tones. "He could sing through his apparatus, but could not talk," for the reason that he broke the contact of his electrodes and interrupted the current. The apparatus, however, under expert manipulation, is capable of transmitting speech, though this was not accomplished until after Bell's discovery that the true way to transmit speech was to operate on an unbroken current. 126 U. S. 540-545.

The receiver is represented by Fig. 2. Its plate is vibrated by electrical undulations, and the vibrations of the plate produce sound waves. The receiver is covered by another patent to Berliner, No.

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233,969, dated Nov. 2, 1880. The claims in issue are as follow:

"1. The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described."

"2. An electric speaking-telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate."

The patent contains the following disclaimer:

"I do not claim that I am the first inventor of the art of transmitting vocal and other sounds telegraphically by causing electrical undulations similar in form to the sound-waves accompanying said sounds. Neither do I claim that I am the first who caused such electrical undulations by varying the resistance of an electric circuit in which a current was passing."

The last sentence has reference to Bell's variable-resistance method described in the *Telephone Cases*, 126 U. S. 531, 536, 537, 538, and covered by the following claim of Bell's patent:

4. The method of producing undulations in a continuous voltaic circuit by gradually increasing and diminishing the resistance of the circuit, or by gradually increasing or diminishing the power of the battery, as set forth.

On page 323 of 126 U. S. is shown "Bell's Centennial Liquid Transmitter," an instrument operating by the variable resistance method covered by claim 4 of Bell's patent 174,465, March 7, 1876.

Though Bell's patent made no claim for apparatus operating by this method, his specification contained this language:

"Electrical undulations may also be caused by alternately increasing and diminishing the resistance of the circuit . . .

"The external resistance may also be varied. For instance, let mercury or some other liquid form part of a voltaic circuit, then the more deeply the conducting-wire is immersed in the mercury or other liquid, the less resistance does the liquid offer to the passage of the current. Hence the vibration of the conducting-wire in mercury or other liquid included in the circuit occasions undulations in the current."

Prof. Wright, complainant's expert, says of this extract from Bell's patent:

"This described a liquid transmitter, and I believe that any one familiar with electrical science, and having a knowledge of the art as it was at that time, would have been able to construct an apparatus which could be used for the transmission of speech."

Speaking into the mouthpiece vibrates the diaphragm, whose movements cause the conducting wire attached to the diaphragm to move up and down in the liquid, thereby permitting more or less electricity to pass according to the extent of immersion. The liquid may be acidulated water or mercury.

Professor Cross, complainant's expert, says that this was the apparatus with which Bell first successfully transmitted speech, and that "the apparatus was and is perfectly operative." It was exhibited at the Centennial Exhibition in 1876. Professor Cross describes the operation as follows:

"When the diaphragm vibrated the wire dipped more or less deeply beneath the surface of the liquid, so that that portion of the wire from which the current flowed into the liquid was alternately increased and diminished, thus increasing and diminishing the resistance at that place, and so producing electrical undulations."

A comparison of this instrument with that of Berliner's patent is of principal importance in this case. The defendants rely upon it, not as a complete anticipation of Berliner's instrument or invention, but as an anticipation of the broad claims of the patent, and of the broad claims of the complainant's counsel and experts as to the character and importance of Berliner's invention.

It appears by Berliner's testimony that, before constructing his instrument, he had carefully studied Bell's first patent, and that the metal plate or diaphragm A, of Fig. 1, was taken from Bell's second patent, 186,787, Jan. 30, 1877.

What appears in Bell's patents, or in Bell's liquid transmitter, cannot be claimed as novel with Berliner. Upon comparison, we find the following resemblances: Each is apparatus for practising Bell's art, process or method of "transmitting vocal or other sounds telegraphically. . . . by causing electrical undulations similar in form to the vibrations of the air accompanying. . . vocal or other sound." Bell's patent. The treatment of the current described in the Berliner patent is the same as Bell's. Each is apparatus for practising Bell's art by Bell's variable-resistance method, *i. e.*, "gradually increasing and diminishing the resistance of the circuit." Bell's patent, claim 4. The method of treating the resistance of the circuit is the same in each. Each receives the sound waves upon a diaphragm, which vibrates and effects changes in a circuit in which an unbroken battery current is passing, thus producing electrical undulations similar in form to sound waves. In each, there are electrodes in constant but variable contact. Each operates by a varying contact. In each, pressure is exerted upon the diaphragm by sound waves, and by one moving electrode upon another electrode; so that in each there is pressure between electrodes. In each, there is produced by the force expended upon the diaphragm a weakening and strengthening of the current, through the weakening and strengthening of physical and electrical contact of electrodes. Bell's liquid transmitter is, therefore, a complete anticipation of Berliner's transmitter in these particulars: In the use of a battery current, instead of a current generated by the transmitter instrument, as in Bell's magneto instrument illustrated in Bell's patent. (See 126 U. S., page 5, Fig. 7.)

In the use of electrodes in constant contact with each other, and forming part of a circuit which includes a battery.

In the use of the pressure of one electrode upon another to strengthen an electrical contact, and of a relaxation of pressure to weaken the electrical contact.

It is, therefore, true, as the defendants contend, that claims 1 and 2 of the patent in suit, taken as they read in the ordinary sense of the words used, without limitation as to the size, shape, or materials of the electrodes used, are anticipated by Bell's liquid transmitter.

It may clear the discussion of this case if we observe that two distinct questions have been confused. Does Bell's liquid transmitter anticipate the first and second claims? Does Bell's liquid transmitter anticipate an invention made by Berliner?

The complainant misstates the position of the defendants, saying on its brief that "The National Company contends that the 'Bell liquid transmitter,' briefly referred to in Mr. Bell's great telephone patent of 1876, was a microphone and anticipated Berliner." The defendants do not so contend. The term "microphone," according to the complainant, denotes an instrument having solid electrodes. The defendants do not contend that Bell's liquid transmitter was a microphone. To the defendants' assertion that the claims cover Bell's liquid transmitter, as well as Berliner's, the reply is that Bell's liquid transmitter does not anticipate Berliner's instrument nor Berliner's actual invention. This does not meet the true issue. The anticipatory effect of Bell's patent and of Bell's liquid transmitter cannot be ignored. The failure of the complainant to recognize this fully is a weak point in its argument.

It is clearly established that Bell was a prior inventor of a constant but variable-contact transmitter. It is also apparent that in every transmitter having a constant but variable contact of opposing electrodes (a contact varying according to the vibrations of a diaphragm), there must be, as an invariable and necessary accompaniment, a variation of pressure between the electrodes. Whenever, in transmitting sound, pressure is expended by one electrode upon an opposing electrode, there is varying pressure, whether the second electrode be of water or mercury, as in Bell's liquid transmitter, or of powdered carbon, felt saturated with water, or plumbago, as in Edison's devices, and whether the second electrode yields to the force exerted upon it, or resists this force. It is manifest, therefore, that when Bell invented a transmitter in which there was a varying contact between opposing electrodes, he also invented a transmitter in which varying contact was inseparably associated with varying pressure. To claim broadly variable pressure between electrodes is to claim in other words variable contact of opposing electrodes. The claims of the

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patent are such as could properly be made, if at all, only by the inventor of the first transmitter having a constant but variable contact of opposing electrodes, *i. e.*, Bell. As varying pressure is a uniform accompaniment of varying but constant contact of opposing electrodes, one who desired to define Bell's liquid transmitter, so as to distinguish it from the Bell Magneto instrument, which had no electrodes in contact, or from the Reis transmitter (with an inconstant or broken contact), might do so by reference to either of the novel features of Bell, and say that its novelties were either "constant contact" or "variable pressure," or both. Either of the two names will distinguish a constant-contact transmitter from the Bell magneto instrument, or from the Reis apparatus when operated according to Reis's method. Definition by a single novel feature, under some circumstances, is quite as good as definition with a full enumeration of particulars, but it may lead to fallacy by creating two names for one thing. Berliner was not the inventor of the first constant-contact transmitter. His instrument cannot be distinguished from previous or subsequent constant-contact transmitters by referring to a single feature not novel with him, but possessed by several transmitters. Therefore he must point out, in his claims, some distinctive difference between his invention and what is disclosed in the Bell liquid transmitter, in order to show his advance in the art. His apparent difference is merely in apparatus, but his apparatus is so inefficient commercially that if his patent is to be construed merely as for apparatus, the complainant's case is hopeless on the issue of infringement. The complainant, therefore, rests its case upon the proposition that Berliner's invention was a "new mode of operation," and from this arise the principal difficulties in the case.

The complainant starts the search for novelty at Bell's magneto instrument, and at the instrument of Reis, and not from Bell's prior variable-resistance transmitter and, upon its brief, contrasts Berliner's apparatus with Bell's magneto transmitter and with the Reis transmitter, first saying of Bell's magneto transmitter:

"The apparatus of Mr. Bell was exceedingly perfect both in its theory and in the practical results which were reached by it. But the currents produced by the transmitter were extremely feeble, since the currents utilized were generated by the transmitter itself; and its motions, as it was actuated only by the sound-waves due to the voice, were but slight."

The brief then says, in italics, "Mr. Berliner remedied this defect," and made a new type of transmitter, which employs Bell's method of transmitting speech. "It is what is known as a variable-pressure contact transmitter. It operates not as did the magneto, to generate the undulatory current produced by the small amount of energy which the voice can communicate to the transmitter, but simply to impress upon the electrical current furnished from another source — practically a battery — variations in strength which correspond to the motions impressed by the voice upon the transmitter."

But this is true of Bell's liquid transmitter, and was true of it in 1876, when it was exhibited at the Centennial. Berliner's transmitter in this respect was not a "new type of transmitter," but merely a species of a new type of transmitter invented by Bell.

It is a remarkable fact that, in spite of the testimony of Professor Wright that the Bell patent sufficiently disclosed a liquid transmitter to enable a person skilled in the art to make one, and in spite of the testimony of Professor Cross that the Bell liquid transmitter was, and is, perfectly operative, the complainant should ignore the Bell patent and Bell's liquid transmitter, and explain Berliner's invention by saying that in Bell's magneto instrument the currents were very feeble, since they were generated by the transmitter itself, and by saying, in italics, "Mr. Berliner remedied this defect."

Such a contention cannot be sustained. Bell's patent suggested the use of a battery current, and Bell's liquid transmitter used it in 1876. Berliner's apparatus has never been used commercially and made no practical advance on Bell's magneto transmitter.

The error of attributing to Berliner the credit of an advance upon Bell in the substitution of a battery current for a current generated by the transmitter rendered necessary a foot-note to the brief:

"It is true, of course, that Mr. Bell also suggested in his magneto patent that he could produce an undulatory current by varying the resistance, but he had made no suggestion whatever that this could be done by varying the pressure between two electrodes in contact."

After the opinion of the Supreme Court in the *Telephone Cases* as to the variable-resistance method (126 U. S. 538, 246, 247), in explaining the importance of Berliner's work, counsel for the Bell Telephone Company call Bell's great patent "Bell's *magneto* patent," and ignore the instrument with which Bell first transmitted speech.

This is a confession of fundamental weakness in the complainant's case. It is essential to the complainant's argument that the true scope of Bell's variable resistance method, and of Bell's work in applying that method, should be ignored, in order that the Berliner patent may be construed as for a new "method" instead of for practically useless apparatus for practising the variable-resistance method of Bell.

The complainant further proceeds to show the nature of Berliner's invention by stating, as a main proposition on the brief, "Berliner's inventions do not reside in the structure involved." Berliner, "using substantially the old Reis structure," produced a "new mode of operation." In explaining this, the brief again ignores Bell's liquid transmitter and reverts to Reis, quoting the language of the Supreme Court to the effect that the question is "not as to the character of the apparatus, but as to the mode of treating the current of electricity on which the apparatus is to act." It refers to Berliner's "new electrical mode of operation," and also quotes the language of Professor Cross:

"Structure here is not the controlling element. In machines generally the operation and the result are absolutely controlled and defined by the structure and organization of the machine. But this simple contrivance is more like a tool, because it can be compelled at the pleasure of the operator to perform the breaking operation and produce the broken Reis current, or to perform the variable-pressure operation and produce the undulatory current."

Berliner's "new electrical mode of operation" or mode of treating the current is new as to Reis, because it has that novelty which the Supreme Court has decided to constitute Bell's advance upon Reis. His mode of treating the circuit is new as to Reis in that the contact is not broken — but this is Bell's novelty.

The complainant's patent does not refer to any new treatment of an electrical current, and disclaims novelty in causing electrical undulations similar in form to sound waves.

As a substantive part of its case, the complainant has claimed for Berliner as distinctive features the use of a battery current and constant contact of electrodes, both of which are Bell's. Although the patent expressly disclaims that Berliner was the first to cause electrical undulations by varying the resistance of an electrical circuit in which a current was passing, and disclaims novelty in the production of electrical undulations similar in form to sound-waves, the brief in effect retracts this disclaimer by showing Berliner's novelty against a prior art, from which is excluded what the patent by its disclaimers acknowledges was old at the date of the application. Bell's liquid transmitter is not in the prior art of the complainant's case. The attempt to dispose of that apparatus by characterizing it as a mere laboratory experiment, after Professor Cross's evidence that it is an operative instrument, and after it was presented to the Supreme Court as a speaking telephone (126 U. S. 247, 322), is not successful. This instrument is quite as important after the expiration of Bell's patent as it was before. It was the primary instrument employing the variable resistance method, and after it the problem was to improve upon Bell's electrodes. Improvement upon the resistance of the circuit was not a new art or method. Whatever the particular kind of resistance, whether "contact resistance" or "mass resistance," the method of varying it is Bell's. I am of the opinion that upon Bell's liquid transmitter the defendants have established their first defense, to-wit:

"In the state of the art of electrical telephony in 1877, there was nothing in the Berliner transmitter of patent No. 463,569 patentable over Bell as an art (Claim 1), nor anything patentable as mechanism, unless in the substitution of a solid metal electrode

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for Bell's mercury electrode, which substitution only reproduced a Regnault or a Reiss instrument, to be operated by Bell's method."

It appears also that there can be only two narrow grounds upon which the Berliner patent can stand:

1. That it was patentable to apply Bell's variable-resistance method to the apparatus of Reis.

2. That it was patentable to substitute a solid metal electrode for Bell's mercury electrode.

I am further of the opinion that these claims are invalid for excessive breadth, under the decision of the Supreme Court in the Incandescent Lamp Patent, 159 U. S. 465, 476, as attempting to monopolize the use of the pressure of one electrode upon another to effect changes in the circuit, and also as attempting to monopolize the use of apparatus operating by changes of contact between opposing electrodes; even if the electrodes be limited to solids.

Professor Cross, upon the *prima facie* case, was asked:

"Is the patent confined to any particular sizes, shape or materials of the electrodes? and replied that "The patent is not in any way thus limited. . . . There is no limitation as to this matter in Claims 1 and 2 of the patent."

In argument, counsel for complainant, in setting forth the "remarkable character of Berliner's invention," and its great importance, state:

"That this invention is broadly covered, and conceded to be broadly claimed in the patent in suit, is stated in this bill" (brought by the Government for the annulment of the patent); "'And your orator avers further that the broad claims of said patent cover in their scope *every form of constant-contact telephonic transmitter which it is possible to make;* and that, so far as can be foreseen, the possession of this patent, if it is valid, will continue to the respondent company without substantial diminution during the full term thereof the same close monopoly of the art of telephony in the United States which it has enjoyed under said patent to Bell 174,465.'"

I believe these claims to cover broadly all transmitters having variable-contact of opposing electrodes. They certainly are broad enough to cover every variable-contact transmitter that has been presented in this case.

The concessions made by the complainant are sufficient to prove that these claims are what were termed in *Carlton* v. *Bokee*, 17 Wall, 471, "ingenious attempts to expand a simple invention of a distinct device into an all-embracing claim, calculated by its wide generalizations and ambiguous language to discourage further invention in the same department of industry and to cover antecedent inventions." It is a familiar rule that a generalization or definition that is too broad cannot be made good by making an arbitrary exception of each case that comes within its terms but which should not have been included. A single contrary example destroys the generalization.

The complainant claims broadly variation of pressure between electrodes in constant contact. This first conflicts with Bell's liquid transmitter. A liquid electrode is then excepted, but the exception of a liquid electrode still leaves the complainant claiming the mode of operation by variable contact for all electrodes other than liquids.

The claims limited to solid electrodes next come into collision with devices of Edison. The effect of these devices as anticipation will be considered later. We now consider them merely in connection with concessions of the complainant that the claims should not cover them.

This device has solid electrodes, and was an operative telephone in February, 1877. It is the basis of Edison's patent 474,230, applied for April 27,1877. Its electrodes are a diaphragm of sheet metal, and a disk of hard rubber coated with plumbago, or a disk of some conducting metal or substance.

In this apparatus Edison employed a battery current and constant contact. There was variable pressure between solid electrodes as in Berliner's apparatus. The complainant excepts this from the Berliner patent by saying that it operates by varying surface area of contact, and by varying the length of the path of the current outside of the area of contact, which is said to be different, theoretically and practically, from Berliner's method. It is, nevertheless, within the claims.

The claims are next confronted with apparatus of Edison dated April 1, 1877, which has solid electrodes. It consists of a diaphragm and "five vertical springs, each provided with a sleeve carrying a cylinder or button of hard-pressed plumbago fastened to a bar of insulating material. All the plumbago buttons were in contact, and the one at the end rested against the diaphragm. The circuit was complete from the first spring through all the carbons to the last spring." This the complainant says is not a variable-pressure transmitter, for the reason that Edison intended, by the vibration of the diaphragm, to compress electrodes of plumbago; thereby changing the molecular condition of the material of a part of the circuit. Counsel distinguish this, and impliedly limit the electrodes of the patent to solid electrodes having "transition resistance" due to a loose joint, by saying that the Edison device does not operate by variation of transition resistance. There can be no question but that, if Berliner had preceded Bell, Bell's liquid transmitter would infringe claims 1 and 2, both as to constant contact and variable pressure. If Berliner had preceded Edison, either of the devices shown would infringe the Berliner claims. The logical difficulty with the claims of the Berliner patent, in view of Bell's liquid transmitter and its position in the prior art, is that in attempting to define and mark out Berliner's novelty, they refer only to features that are common to Bell and Berliner, and not to the distinctive difference. It is definition "per genus," and not definition "per genus et differentiam," and the genus is Bell's. This is a defect not only of the claims, but of what may be termed the "variable-pressure" aspects of the complainant's argument. Practical accuracy, logical rules of definition and rules of law alike require that a definition shall include a statement of the distinctive difference. If we stop short of that, we err by being too vague. Though the complainant contends with great earnestness that Edison's devices are distinguishable from Berliner's, yet it is apparent that, in the same way that the claims fail to express a distinctive difference between Bell's liquid transmitter and Berliner's, they fail to express a difference between Berliner's and the devices of Edison.

To the objection that the claims are so broad as to include these devices, it is obviously no answer to reply merely that these devices are not analogous.

I am of the opinion, therefore, as the claims are statutory requirements, prescribed for the purpose of making the patentee define precisely what the invention is — and as these claims are so broad as to include every transmitter of the general class of which Bell was the first inventor, and which is exemplified in his constant contact transmitter — that they are invalid for excessive breadth, and for a vague generality which makes them a constant menace to all inventors who may seek to improve the art of telephony by applying what Bell has taught as to the practicability of operation by the constant but variable-contact method. This is also true if the electrodes are limited merely to solids.

By claiming "variable pressure of electrodes" as an art or method, the complainant seeks to monopolize an indispensable feature of every constant-contact transmitter having varying contact and opposing electrodes, and to suppress all subsequent invention in the same field. Walker on Patents, Sec. 14. Counsel say that the method of operation by variable pressure is available "in the case of all electrodes which have surfaces between which there may be varying pressure." It is obvious that this language does not exclude even the liquid electrodes of Bell; and that, as all solids have surfaces of this kind, it includes the solid electrodes of Edison.

The final position of the complainant, upon the supplemental brief, is that the method of varying resistance in a battery circuit, "by causing sound-waves to vary pressure between electrodes in contact" so as to "strengthen and weaken the contact" is a more specific and hence different thing from the mere effecting of "some physical changes in the path of the current."

Counsel fail to meet the actual contention that it is not a specific description sufficient to distinguish Berliner's method from effecting such physical changes in the path of the current as occur in Bell's liquid transmitter and in various devices of Edison.

I am of the opinion that the language of these claims is clear and that no resort to the specification is necessary to explain its meaning. They are not claims made in the infancy of an art by an unskilled inventor. They were put in the present form more than two years after Edison's carbon telephone had

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been placed on the market. They cover, if not every form of constant-contact transmitter which it is possible to make, at least every form that has been presented. They cover the use of variable pressure exerted by one electrode upon another, to vary the resistance of the circuit. They cover also all transmitters having a variable contact of opposing electrodes. They cover under a new form of words what was previously invented by Bell. To save these claims it is necessary, not to explain them by resort to the specification, but to ingraft upon them restrictive qualifications which the patentee omitted to point out.

This may not be done "for the purpose of changing it and making it different from what it is." *White* v. *Dunbar*, 119 U. S. 47; *Howe Machine Co.* v. *National Needle Co.* 134 U. S. 388-394; *Paul Boynton Co.* v. *Morris Chute Co.* 87 Fed. Rep. 225; *Day* v. *Fair Haven Railway Co.*, 132 U. S. 98, 102; *Merrill* v. *Yeomans*, 94 U. S. 568, 570; *Railroad Co.* v. *Mellon*, 104 U. S. 118; *Incandescent Lamp Patent*, 159 U. S. 465-472.

Later in this opinion, we will consider further the merits of the complainant's contention as to the importance and scope of what Berliner is said to have accomplished. Even if it be assumed that the complainant is lawfully entitled to the patent upon which its arguments are based, I am of the opinion that the argument by which the complainant seeks to show that the patent discloses an invention of broad character and scope is logically and legally unsound, and that what is described in the patent was, in view of the state of the art, of slight value and of narrow scope.

But before considering the reasons for this conclusion, we will consider the question of the validity of the complainant's title to the Letters Patent.

The case presents this remarkable feature,— that the application in terms denies that the instrument of the patent is adapted to the transmission of speech. The patent covers the transmission of speech by an instrument which the application does not describe as a speech transmitter, but, on the contrary, says is not adapted to the transmission of speech. Berliner's application filed June 4, 1877, was not for the invention covered by Letters Patent issued to the American Bell Telephone Company, as Berliner's assignee on Nov. 17, 1891. Upon this question, we need consider only the single feature of "electrodes in constant contact" for speech transmission. The inquiry whether the application describes the "variable-pressure" method of Berliner is the same as the inquiry whether it discloses the constant but variable contact method of Bell, and whether it calls for the use of an unbroken current. The Supreme Court, in the *Telephone Cases*, 126 U. S. 544, 545, found that Bell discovered the true way to transmit speech; "to operate on an unbroken current by increasing and diminishing its intensity;" and that Reis, who preceded Bell, failed because he operated with a current made intermittent by the opening and closing of the circuit, saying:

"To follow Reis is to fail, but to follow Bell is to succeed. The difference between the two is just the difference between failure and success. If Reis had kept on he might have found the way to succeed, but he stopped and failed."

We shall find that Berliner did follow Reis, as a matter of fact, and that he failed, as a matter of fact, through attempting what was described by one of the examiners as a "kind of cross between the microphone and the Reis circuit-breaking operation." Our present question, however, is merely whether a document sworn to and filed by Berliner discloses a constant-contact speech transmitter, upon an examination of its text and drawings.

The examiner, on Jan. 31, 1882, decided that it did not, and filed on appeal before the Commissioner an answer which in my opinion conclusively shows that the invention disclosed in the application was not a speaking telephone, and not a constant-contact speech transmitter. The rejection of amendments by the examiner was overruled by the Commissioner, but it does not appear that he answered the specific reasoning of the examiner. A second examiner also made a ruling adverse to the amendments, which was reversed by the Board of Examiners on appeal, in a decision which stated:

"It seems to be clear from this review of the original specifications that, so far as can be judged from the language used, two things were disclosed by it; first, the transmission of musical sounds whether uttered by the human voice, as in singing, or produced by musical instruments; and, secondly, the transmission of speech by means of a make and break of contact through the use of the secondary device. It is to be noted, however, that even as to speech, Berliner's statement is merely that he had succeeded in reproducing the vowels and other special sounds."

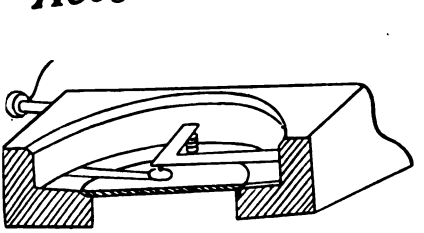
The Board held, however, that the Commissioner's prior decision permitting amendment, bound the Board and, reversed the examiner. This opinion of the Board as to the meaning of the language used seems sound. While this Court is not bound by these decisions of the Patent Office, and looks to them merely as interpretations of this document referred to in both briefs, it may be said that the weight of reasoning is very decidedly with those officials who found that the application was not for a constant-contact speech transmitter, and that the weight of decision in the Patent Office upon the sufficiency of the original application is decidedly against the complainant.

We will consider this matter on its merits. A comparison of the two documents seems to me to settle this question.

There has been in this case a great abuse of the use of expert testimony. Experts have offered their views upon questions that are entirely outside their province. They have entered into argumentative discourses upon the meaning of a document which is plain upon its face and expressed in terms of ordinary speech that require no expert explanation. The question of the meaning of the text, and the question of mistake in writing the text, questions of fact as to the intention of the applicant when he wrote the text, evidence as to the state of the art having no bearing whatever upon the meaning of terms, and arguments as to the meaning of isolated portions of the text, have been so confused as to obscure the real questions.

Did the original document filed by Berliner, read as a whole, disclose the invention of the patent; did it disclose the fact that Berliner had discovered that speech could be transmitted with the instrument of the patent; did it show that Berliner had made any advance upon Reis, or intended to claim anything more for the instrument of the patent than the transmission of musical sounds? The question whether certain portions of this document were inserted through mistake, and whether, when amendments and corrections are made, the application discloses the invention, is, of course, an entirely distinct question that should not be confused with the present inquiry. The application referring to instruments substantially similar to those of the patent in suit, says:

"If now the plate of one instrument, as in Fig. 3, is vibrated by sound waves (which happens whenever any kind of sound is uttered or produced by musical instruments in its neighborhood, every wave or vibration that strikes the plate will cause a



REIS TELEPHONE BREAK APPARATUS.

weakening of the point of contact *x*, or also, if the sound is sufficiently strong, a break of the electric current at that point.

It is evident that changes thus occurring at the plate of one instrument will be noticed at the plate of the other, or in any such instruments that are situated within the same electrical connection; and as often as one plate is caused to vibrate just so often will the others vibrate, caused by the break or the weakening of the electrical current. The same kind of sound therefore which affects the

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plate of the first instrument will be reproduced by the plate of the others."

Immediately following this is a statement which seems conclusive of the question whether the application claims a constant-contact operation for speech transmission.

A statement by Berliner, under oath, on June 4, 1877, which, unless proven to be a clerical mistake, is fatal to the complainant, not only on the question immediately under discussion, but on the fundamental question of whether, in fact, Berliner invented a constant-contact speech transmitter:

"These simple instruments will reproduce any musical sound uttered in the neighborhood of one of them; but for the reproduction of special sound such as speech they are not adapted for the following reasons:

In accepting the graphical name of wave for a vibration we must consider the same to have two dimensions, length and depth or height. In Fig. 7 I have represented three sections of waves, all of the same length and height, yet they differ in shape and their highest point is not always situated in the centre of their length. Such is the case with sound waves of various kinds of sounds. In a pure musical tone the shape of the wave is entirely regular like in Section I, but in every other sound this is not the case. It is therefore evident that the apparatus described thus far can not but transmit a pure musical sound because it transmits only the number of vibrations per second which is equal to the lengths of the waves, but nothing of the nature of each wave and the shape of their curves is recorded."

The statement of the insufficiency of these instruments to transmit speech is accepted by the following description of the instrument, which was filed by Berliner as his model speech-transmitter:

"This I accomplish, however, by situating within the vibrating field of the plate A a second screw E. In Fig. 6 the dotted line indicates the vibrating field of the plate B, the screw in contact with the plate, and E, the second screw. It will now happen in special sounds (meaning the nature of every sound besides its certain musical pitch) that the plate will not always strike the screw E in the middle of the duration of one wave or vibration, and taking, for instance, the duration of one wave to be one minute, the plate in special sounds will sometimes strike the screw E sometimes after twenty or twenty-five seconds from its beginning. This, now, is exactly recorded by this secondary screw E, which also makes an electric connection whenever the plate A touches it, and at the receiving apparatus these special sounds will therefore be noticed. I have thus succeeded in reproducing a great many special sounds, such as the vowels and others. The principle of reproducing special sounds by break and make of contact rests mainly in the use of this secondary contact screw.

In the drawing the point of this second screw consists of a piece of spring steel bent in semicircle; this is sometimes advantageous, but not absolutely necessary.

It will be observed that this drawing shows, in connection with the two pins, a hearing tube K and a speaking tube O.

It is idle to contend that, with this portion of the specification retained, and read in connection with the claims and other parts of the specification, the application was for a constant-contact speech transmitter. Applying the legal rule that a document must be read as a whole, and reading it as it stands, it is fatal to the complainant's contention. The application expressly disclaims speech transmission by the instrument of the patent and claims as a speech transmitter a double-pin instrument operating to make and break the contact of electrodes. Berliner's model filed with his application was a double-pin instrument. The patent calls for constant contact of electrodes and an unbroken current; the application for an interrupted contact and a broken current. The Supreme Court has decided that these methods are radically distinct. (126 U. S. 544, 545.) We can find nothing upon the face of this document that requires the Court, as a matter of construction, to reject any portion of the text, or to interpolate any words which the context proves to have been omitted. The complainant contends that the statement that the single-pin instruments are unadapted for the transmission of speech is inconsistent with other portions of the text. It is said that the phrase, "Whenever *any kind* of sound is uttered or produced by musical instruments," is an assertion that speech is to operate the single-pin transmitter. But is this so? The word "uttered" is used in the following paragraph to indicate the production of musical sound, thus:

"These simple instruments will reproduce any *musical sound uttered* in the neighborhood of one of them, but for the reproduction of special sound, such as speech, they are not adapted."

The word "uttered" is used elsewhere in the application in the sense of produced. The Board of Appeals said, "The use of the word 'uttered' in the latter part of the specification is significant, for, while it might appear from its use in the former part that it meant speech, this presumption is overcome by its use in the latter part in connection with musical sound." This is proper construction. The phrase has no reference to speech transmission. The word "uttered" being ambiguous, is to receive that interpretation which reconciles it with the rest of the text, rather than that which brings it into conflict therewith. It is then said that Berliner has stated that a "weakening of the current can be observed," and that changes at the transmitter that weaken the current can be observed at the receiver. But there is no inconsistency between the statement that weakenings can be observed and the statement that the instruments will not transmit speech. If some audible effects are referred to as produced by weakening the current, this is not speech. The document does not claim that, within the range of weakenings of the contact of the pin and diaphragm, speech can be transmitted; on the contrary, this is denied, and another inconsistent method is shown. Berliner has described the operation of the musical sound transmitter as a composite operation of weakenings and breaks of the current, saying that, "as often as one plate is caused to vibrate, just so often will the others vibrate, caused by the break or weakening of the electrical current." The statement relative to the irregularity of the sound waves and that nothing of the nature of each wave and the shape of their curves is recorded, applies to the composite operation and to both parts of it,— the weakenings as well as the breaks. The reproduction of special sounds is attributed solely to the supposed fact that the height of the waves is recorded by a contact with the second screw following a break of the circuit. It is said that the words, "any sound," include speech, and that therefore the subsequent statement that speech cannot be transmitted is inconsistent therewith.

But the words, "any sound," must be interpreted in connection with the specific exception of "special sound such as speech," which follows.

The contention that the particular clause is a contradiction of the general clause, is in effect a claim that a specific exception to a general statement should be rejected as inconsistent. We may test the validity of this method of construction by applying it to other text: "Of every tree of the garden thou mayst freely eat, but of the tree of knowledge of good and evil thou shalt not eat of it." Upon such a mode of construing text, the general permission is inconsistent with the special exception; therefore the exception should be eliminated. Such a mode of construction doubtless led to the fall of man. Legal rules of construction require that particular force be given to the specific exception (*Bock* v. *Perkins*, 139 U. S. 628, 634, 637.)

It is further contended that the passage read as it stands would "make nonsense of the first three claims, which would be for inoperative combinations; the first of which would be entirely indistinguishable from the Reis transmitter, and the other two substantially indistinguishable." But this is not so. The first claim of the original specification is as follows:

"1. An instrument for transmitting and reproducing sound-waves by the agency of electricity, consisting of a metallic diaphragm or other vibratory medium connected to or forming part of one pole of an electric circuit and arranged in contact with the opposite pole thereof, and capable of being put into vibration by the action of the electric current as set forth."

The second is substantially the same. If this claim as counsel for the defendants contend, is a claim for a receiver only, there is certainly no inconsistency. The words, "capable of being put into vibration by the action of the electric current," have no application to a transmitter, and support this view. The complainant relies, however, upon the words,

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"for transmitting," to overcome the force of this clause.

In *United States v. Bell Telephone Co.*, 167 U. S. 264 it was said; "In a sense the receiver is also a transmitter, for it passes the sounds from the wire to the ear." If, then, we should find, that reading this claim as for a transmitter, it was inconsistent with other portions of the text, we should, as a matter of construction, avoid this inconsistency by interpreting the word "transmitting" in the sense referred to in the opinion of the Supreme Court, following the rule that the text should be harmonized if possible. But, on the other hand, the claim can be read as for both a transmitter and a receiver without encountering any inconsistency. The single-pin transmitter's functions are described elsewhere as the production of musical sounds. A claim is not nonsensical that describes an instrument both as a receiver and as a transmitter of musical sounds, even if the instrument as a transmitter is substantially the Reis transmitter. Many patents describe and claim in clear language that which has been invented previously; they cannot, for that reason, be characterized as nonsensical.

The third claim of the application is:

"The combination in one circuit of two or more vibratory diaphragms and contact pins adapted to operate similarly for the production and transmission of sound waves when one diaphragm is caused to vibrate by means of any sound as substantially as set forth."

This last clause makes particular reference to the specification and limits the function of the two instruments to the transmission of musical sound. A novelty is shown in the claim, and there is no nonsense here. There is nothing on the face of this text that requires us either to reject any part of it or interpolate anything as omitted.

Reading this document by itself, it is clear and consistent. Upon the view that there was no intention to describe or claim a constant-contact speech transmitter, there is no inconsistency or confusion. When we attempt to read it as for a constant-contact speech transmitter, then all is confusion, inconsistency and contradiction. The complainant contends that the patented invention was both described and claimed in the application before a word was altered by amendment; but, in support of this contention, argues that there was error in the expressions used and mistake in the text.

In considering whether portions of this document disclose a constant-contact mode of operation for the transmission of speech, the complainant contends that the specification was addressed to a person skilled in the art, and that this person would have known that there was no novelty in make and break of contact, and that speech could not thus be transmitted. It is then argued that for this reason the language must be interpreted as if the breaks were referred to as accidental. But surely such an assumption could not authorize us to reject an express statement by Berliner in this very document that he was attempting to reproduce special sound "such as speech" by make and break of contact; and that he had thus succeeded in reproducing a great many special sounds, such as the vowels and others. The document itself, on its face, disposes of the assumption for purposes of construction, that Berliner knew better. Circuit breaking by two pins was new, not old. Berliner claimed it for speech transmission; and shows in his drawings a circuit breaker provided with a mouthpiece and ear-piece, and refers to this instrument when he says that "the operator is not in need of handling the instrument sidewards or moving his head while a conversation is carried on." And there seems to be no substantial ground for the statement of Professor Cross that the "circuit-breaking operation was known to be old, worthless and incapable of producing speech." The examiner considered many applications for circuit-breaking apparatus as late as 1882; and it appears that a circuit breaking transmitter was greatly desired in order to avoid the Bell patent.

But even did the document elsewhere on its face fail to disclose the fact that Berliner was attempting a make-and-break operation, and were we simply construing those passages that relate to the single-pin instrument, we could not reject a distinct statement because it was erroneous as a statement of fact.

The attempt to construe this instrument according to supposed knowledge of the art completely fails, because Berliner expressly states that he thought otherwise than the expert is supposed to think as well as because on a question of the construction of text, a reference to the state of the art is permitted only for purposes of explanation and not to contradict plain language. In *Simpson v. Holliday*, 1 L. R. Eng. & Irish App. 315, 322, it was said:

"This does not warrant us in giving effect to a specification claiming two things, one practicable and the other impracticable, because a skilful workman would know that one of them could not be acted upon and so would confine himself to the other. This would not be to construe a specification according to the language of workmen instead of according to our ordinary language, but to reject something claimed by the patentee, because a workman would know that it was an unjustifiable claim."

In *Clark v. Adie*, 2 App. Cases, 436, Lord Blackburn said:

"When it is attempted . . . to say that inasmuch as these specifications show, or are alleged to show, matter which, upon a fair construction of the specification claimed by the patentee, were old at the time that the patent was taken out, and were generally known to be old, therefore the specification must be so construed as not to include them, that seems to me to be both contrary, so far as I know, to the cause of decision and contrary to principle . . . It would afford a very simple recipe for saying that no patent should ever be upset upon the ground of want of knowledge. If, when you say you can show that a thing was old at the time the patent was granted, you are to construe the specification as not intending to claim that, because the man who claimed it would be suicidal and foolish, it would be a recipe for saying you shall never upset a patent at all for want of knowledge."

The question which counsel undertake to argue is, What does the document say? This is a question entirely distinct from the question of what it might have said or what it should have said, and from the question of mistake. In *Badische Anilin und Soda Fabrik v. Kalle*, 94 Fed. Rep. 169, upon the question whether a certain document disclosed an invention so as to constitute an anticipation, it was argued that a certain statement was a mistake. Judge Coxe said:

"The court has simply to consider what the publication in question has contributed to the art. If it fails to show the invention which it is said to anticipate, the contention that its author knew enough to write an anticipation and intended to do so is grotesquely irrelevant."

The argument whereby the complainant endeavors to show that the original application could support the patent in suit, is a labored attempt to place upon plain and unambiguous language forced interpretations which do not explain, but destroy its natural signification,— interpretations which do not explain, but contradict. I am of the opinion, therefore, that the patent in suit cannot depend upon the original application, since it is for an invention radically distinct from anything described or claimed in the original application.

The radical difference between a make-and-break transmitter and a constant-contact transmitter having been shown by the decision of the Supreme Court, in 126 U. S., the next question to be considered is whether the original application could under legal rules, be so amended as to serve as the basis of the patent in suit. The Supreme Court, in *Railway Company vs Sayles*, 97 U. S. 563, said:

"If the amended application . . . . embodied any material addition to or variance from the original,—anything new that was not comprised in that—such addition or variation cannot be sustained on the original application. The law does not permit such enlargements of an original specification, which would interfere with other inventors who have entered the field in the meantime, any more than it does in the case of reissues of patents previously granted. Courts should regard with jealousy and disfavor any attempts to enlarge the scope of an application once filed, or of a patent once granted, the effect of which would be to enable the patentee to appropriate other inventions made prior to such alteration, or to appropriate that which has, in the meantime, gone into public use."

In no case can there be stronger reasons for applying this rule than exist in the present case. See also *Hobbs v. Beach*, 180 U. S. 383, 396.

I am of the opinion that this patent is invalid

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for the reasons that the power to amend an application does not include the power to change the nature of the invention; that the right to amend or the right to complete an application under Section 4894 does not give the right to transform completely; that the only remedy for a radical mistake in substance so serious as to require a transformation so complete as is here shown is a new application. Robinson on Patents, Sections 561, 635; *Consolidated Elec. Lt Co. v. McKeesport Elec. Lt. Co.*, 40 Fed. Rep. 21-27; *Railway Co. v. Sayles*, 97 U. S. 554-563; *Michigan Cent. R. R. Co. v. Consolidated Car Heating Co.*, 67 Fed. Rep. 121.

The first amendment affecting this controversy was made by Berliner on August 8, 1877, when he struck out the passage denying that the single-pin instruments could transmit speech, and also the claim for the double-pin instrument. The complainant contends that the application thus amended was a sufficient basis for the patent in suit. Assuming that the August amendment amounts to an assertion: "My single-pin instrument can talk. I strike out the reasons why it can't, and also the double-pin instrument, which for these reasons I previously said could talk;" here is a positive and clear contradiction of the former application, and the introduction of matter radically distinct. If this amendment is to bear this construction I agree with the learned counsel for the defendant, that "probably no such flagrant instance of an application filed for one thing and then contradicted into its very opposite, — * * * — can be found in the books." If this was the effect of the amendment, it was clearly inadmissible.

Between the date of Berliner's application, June 4, 1877, and his amendment of August 8, there appeared a publication in the Philadelphia *Press* of July 9, 1877, in which was described a constant-contact variable-pressure speech transmitter, the invention of Edison. The apparatus included a diaphragm with a plumbago electrode in contact therewith.

"This again, is another original discovery of Mr. Edison's, viz. that plumbago changes its electrical resistance with enormous rapidity under pressure, the effect in this application being that when the diaphragm is vibrated weakly contact is made with the plumbago point very lightly, and the resistance of the plumbago being but slightly reduced a weak current is sent out from the battery, and a weak effect produced at the receiving station. When, however, a strong pressure of the diaphragm is effected by reason of the exercise of a more powerful vibration of the voice, the resistence is very greatly reduced and a strong current passes to the line and a strong or loud effect is produced at the receiving station. Hence the amount of power, with all its fine gradations generated by the voice at the transmitting station, is transmitted in its proportions to the receiving instrument, and thus the fine articulation of the voice is obtained."

On July 20, 1877, Edison filed an application for Letters Patent No. 474,231, which covers completely all that is now claimed for Berliner, see 126 U. S. 378. It is apparent that amendments filed after this would interfere with another inventor, and that Berliner's amendment must, in any event, bear date as of August 8, 1877, and cannot relate to the date of filing the original application. But the contention that the amendment of August 8 made the application a sufficient basis for the patent in suit is unfounded. Striking out the only speech transmitter claimed did not introduce a new speech transmitter. The mode of operation remained unchanged,—"as often as one plate is caused to vibrate, just so often will the others vibrate caused by the break or the weakening of the electrical current." If by amendment it was intended to claim the single-pin transmitter for the production of any sound, then it would appear, on reading the amended specification, that Berliner intended to transmit each speech by a composite operation of weakenings of the normal current, and breaks of the current. That breaks were to occur in the operation appears from other portions of the amended specification, thus:

"The operation of my invention is as follows: If a current of electricity of ordinary strength is made to pass through the plate and the screw across the point of contact, . . . the whole amount of electricity will not be able to pass quietly over the narrow point of contact, and the consequence will be that it will accumulate to a state of tension on both sides of the contact, and the passing over of the current at the point of contact will be so violent as to shake the plate off from the screw. The shock will be particularly strong at the setting in and at a sudden ceasing of the current, and a cracking sound will be heard from the plate, but a weakening of said current alone can also be observed by making for example a connection within the same current by a wire and the blade of a knife. When scraping the wire end over a blade of the knife, this scraping is distinctly audible on the plate. Here the current is never entirely interrupted, yet the minute variations and cavities on the plate caused by the structure of the steel and which again cause minute alterations in the intensity of the current are sufficient to shake or vibrate the plate with varying intensity, thus rendering again the same peculiar scraping noise."

This is followed by the language which we have above quoted from the specification, pages 22, 23, *supra*. The language here employed, and the figure by which it is illustrated, have primary reference to a receiver and not to the transmitter; and this supports the contention of the defendants that the principal invention which Berliner sought to cover was the receiver. If, however, this language is applicable also to the transmitter, and if the passing of the current at the point of contact would be so violent as to shake the plate off from the screw, it is apparent that a true copy of the sound waves could not be made upon the line. This would account for the failure of the single-pin instrument as a speech transmitter, and show why Berliner had recourse to the double-pin instrument.

The absence of any specific amendment stating that Berliner contemplated speech transmission with the single-pin instrument, is a strong indication that he did not intend on August 8th that his amended application should be construed as for a speech transmitter. It is apparent that the apparatus with the double pin completely embodies the single-pin instrument. Berliner has stated in his original application all that he could accomplish with this apparatus. He also testifies to his failure with it. When he strikes this out, he strikes out all claim for the transmission of speech.

Further amendments were made on Sept. 8 and 14, 1877. That of Sept. 8 added a carbon contact, afterward cancelled. But after these amendments the application still described in the original language the composite operation of weakenings and breaks. As Berliner's novelty is said not to reside in the apparatus but in the mode of operation, this is the vital point. It is of little consequence that the apparatus is shown, if it is not shown operating in the manner described in the patent. The rewritten specification of October, 1877, still preserves a description of the composite mode of operation, with a new claim for the single-pin instrument operating "by either altering or disconnecting said contact at each vibration."

Constant contact of electrodes is first definitely claimed and described in the rewritten application of Sept. 1, 1880. At that date the invention had been in public use for more than two years, as is conceded. I am of the opinion, therefore, that the defendants have established their second defence. Berliner's June 4, 1877, application did not describe the invention of the patent in suit and was never legally amended to do so. Assuming, however, that by the August amendment the application became sufficient to support the patent, and that such amendment might be made under proper circumstances, we have still to consider the validity of the grounds upon which the complainant claims the right to amend.

There can be no doubt that Berliner had the right to drop out any one of the inventions contained in an application whereby he sought to patent several inventions. That Berliner had the right to drop out claim 4 for the double-pin instrument, and also such parts of the specification as related solely to that instrument, is clear. The question is whether Berliner had also the right to drop out portions of the text which relate solely to apparatus which he retains in the specification, and thereby change or enlarge what remained. The plaintiff's brief says, "His amendments simply withdrew from the specification *another invention* which had proved practically useless, and incidentally cancelled state-

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ments in the description of that invention, etc." This is wrong. Inspection of the document disproves it. There is quoted by counsel, also, the letter of Commissioner Simonds to the Secretary of the Interior, dated Dec. 13, 1892:

"These words describe and claim something which is separable from the main part of the instrument, an addition to what was shown in Berliner's caveat, and they embody an erroneous conception of the natural action involved. The tyro in electricity knows that now."

Referring to the amendment of Aug. 8, 1877, which struck out the passage in question, the Commissioner is quoted as saying:

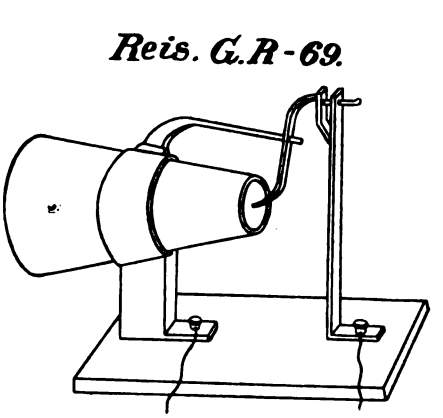
"In making that change Berliner had done two things. He had cancelled the description of an unnecessary adjunct . . . . He had cancelled an erroneous statement of the natural mode of action involved."

This supports the view that the application was not for the invention of the patent in suit, but stated a wrong and impracticable mode of operation. The Commissioner is obviously wrong, however, in stating that "these words describe something which is separable from the main part of the instrument"—"an unnecessary adjunct." This is a main part of the instrument, and of the description of the single-pin instrument. It is erroneous to state, as counsel do, that the words are "words of the specification that describe the double-pin instrument." The entire passage upon which the defendants rely relates solely to a statement of the incapacity of the single-pin instruments, and of the reasons therefor. Following this is a distinct description of the double-pin instrument, and there is no confusion between the two. It is separable from the rest of the document by cutting it out bodily, but in no other way. It is not separable as dealing with a distinct subject. The Commissioner was also manifestly in error in justifying the amendment by the rule "an inventor is not called upon to state and explain the principles of nature involved in the operation of his invention; and, if he does undertake to state them and thus misstates them, the error is not material;" and, "if the inventor undertakes to state the theory upon which his instrument operates and mistakes it, that fact is immaterial."

If an inventor states that he has invented a new machine that works, and theorizes erroneously as to why it works, he may strike out his theory and stand on his fact; and, in construing his document, we may ignore his theory as surplusage and rely upon other parts of the document. But when this inventor states as a fact that he has found that the instrument will not work, and gives an erroneous theory to explain why, when he strikes out his theory he has no fact to stand on. He has not made the instrument operative by discarding his notions as to the reason for the fact that it is inoperative. Strike out Berliner's theory, and his reasons for the inoperativeness of the invention, and there still remains his statement that "these simple instruments will reproduce any musical sound uttered in the neighborhood of either of them, but for the reproduction of special sound, such as speech, they are not adapted;" and these words can be rejected and amended, if at all, on one ground only,—mistake in writing them,—upon clear proof that this was not intended. As a statement of fact they still remain. *Jackson v. Brass Co.*, 72 Fed. Rep. 271.

They cannot be rejected on the ground that they relate to the double-pin instrument and not to the single-pin instrument, since inspection shows that it is not so. They cannot be rejected as theory, for there are statements of fact that remain after eliminating all theory. They cannot be rejected as an erroneous judgment as to the capacity of the machine, for the machine was old; and if Berliner had not learned its capacity to transmit speech he had made no advance upon Reis, and was not an inventor. If the amendment of Aug. 8 made the application good, it was by enlargement of the description of the capacity of the single-pin instrument by cutting off the express limitation that it was only for musical sounds, and thereby converting the application for a musical transmitter into an application for a speech transmitter. I think that it did not have this effect; but, assuming that the complainant's construction of the amended application is correct, it is manifest that the grounds, so far stated to justify the amendment, are untenable.

Counsel say, also, "Suppose it were possible that Mr. Berliner, when he filed the specification of June, 1877, thought that there was or might be some value in the breaking of the contacts in giving that louder, though harsh, sound, can it be contended that he cannot drop that error out when he discovered the contrary?" But this is inconsistent with the claim that Berliner's invention was a new mode of operation. So long as Berliner intended to make use of the breaks in the current, he had not invented a constant-contact speech transmitter. Until he had learned that speech could not be transmitted by a structure in which the two electrodes are not normally constantly in contact, he was following Reis; and, as the Supreme Court has said, to follow Reis is to fail.



REIS TELEPHONE MAKE APPARATUS.

An erroneous judgment as to the practicability of the composite operation of weakenings and makes-and-breaks described in the specification could not be amended as "mistake" or "error." *Manufacturing Co v. Ladd*, 102 U. S. 408-411. Even should we be of opinion that rules of law permitted the amendments in question provided Berliner had, in fact, made the invention, we should still be obliged to find, as a matter of fact, to support this case, that Berliner was mistaken not as to the capacity of his instrument but merely as to the phrases employed in the application.

We therefore consider as the next question: Was Berliner's denial of the operativeness of the single-pin instruments contained in the application of June 4, 1877, a mistake of a scrivener? An examination of this question involves also the substantial question: Had Berliner, as a matter of fact, invented a constant-contact speech transmitter before June 4, 1877? The burden of proof on the question of mistake is upon the complainant. There rests upon the complainant the burden of overcoming the strong presumption arising from the terms of a written instrument. "If the proofs are doubtful and unsatisfactory; if there is a failure to overcome this presumption by testimony entirely plain and convincing beyond reasonable controversy, the writing will be held to express correctly the intention of the parties. A judgment of the court, a deliberate deed or writing, are of too much solemnity to be brushed away by loose and inconclusive evidence." *Howland v. Blake*, 97 U. S. 624-626; *Insurance Co. v. Nelson*, 103 U. S. 544; *Coyle v. Davis*, 116 U. S. 108; *Cadman v. Peter*, 118 U. S. 73; *Moore v. Crawford*, 130 U. S. 122. The doctrine of these cases is fully applicable here.

A reading of the original application affords no evidence of mistake. The application does not disclose the fact that Berliner had made the invention of the patent in suit, nor that he intended to apply for it; it contains no evidence that Berliner had discovered that speech could be transmitted with the single-pin instrument. The document discloses no evidence of an intention of Berliner to include in it the single-pin instrument as a speech transmitter. I adopt the statement of counsel for defendant: "It is impossible to read the specification, with its perfectly lucid and orderly description of

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three specific inventions, following upon three caveats in which they were described in Berliner's own words, and not perceive that that is all he wanted to describe in his application," — excepting, of course, the minor inventions of diaphragms. If this document be read with Berliner's denial of an intention to claim his single-pin instrument as a speech transmitter retained, it is perfectly clear and consistent, showing that he intended to cover a variable-pressure receiver, a sparking and recording receiver, a make-and-break double-pin speech transmitter, a concavo-convex diaphragm, a perforated diaphragm, and the two single-pin instruments for the transmission of sounds other than speech; or we may interpret it as proving an intention to claim the single-pin instrument as a musical transmitter.

On the contrary, if we read it according to the complainant's contention that it was intended to cover a single-pin speech transmitter, the whole document is thrown into inconsistency and confusion. It is obvious that the statements concerning the single-pin instrument and its capacity are such as could have come only from Berliner himself. No scrivener would have volunteered such statements. No scrivener would have volunteered such reasons in support of the statements, nor illustrated them by references to drawings. The alleged mistake does not relate to a matter of form. The statement is of the substance. If there was mistake, it was in the erroneous opinion held by Berliner, and not in any expression of his beliefs or opinions. The word "error" is used by counsel in a double sense to signify, first, a mistake in expression; second, a mistaken belief. There are two distinct contentions, which should not be confused. We will consider later the contention that Berliner had made the invention of the speech transmitter of his patent, even though he believed on June 4, 1877, that his single-pin instrument could not transmit speech.

There is no express reference to the capabilities of the single-pin instrument as a speech transmitter, although, had he made the invention, Berliner could not have failed to state first and principally what he had accomplished with this instrument in the transmission of speech. Had his invention been made, had the adequacy of this means been proved, it is highly improbable that he would have made a claim for the double-pin instrument and a mode of operation which was a reversion to the theory of Reis; or, at least, was intermediate between the constant-contact method of Bell and the current-breaking of Reis. Berliner testifies that the two inventions of the "variable-contact transmitter" (as he terms it) and the contact receiver, consisting essentially of a diaphragm in electrical contact with a pin or screw, were meant to be covered by claims 1, 2, and 3 of the said application. I am of the opinion, however, that claims 1 and 2 were not intended to describe a transmitter, but merely a receiver; and that claim 3 was merely for two instruments for the transmission of sounds other than speech. It is to be observed that the force which actuates the transmitter is the force of the sound-waves; yet claims 1 and 2 contain the clause "and capable of being put in vibration by the action of the electrical current substantially as set forth." This is a characteristic wholly unnecessary to be mentioned in describing a transmitter.

Professor White, however, testifies that the mechanical conditions under which each instrument best performs its functions are also very different; "that, if we have a Berlifier transmitter with steel points in circuit with a Berliner receiver also with steel points, and adjust the two instruments with care for the best performance of their respective functions, speech is readily transmitted and understood. If, now, without changing the adjustments of either instrument, we speak into the receiver, thus making it a transmitter, and listen at the former transmitter, thus using it now as a receiver, it is found that speech cannot be successfully transmitted and received. Sound is heard, but crude and harsh, with much breaking, and scarcely anything can possibly be understood. These experiments show in the most convincing way that the operations of the forces of the two instruments are by no means identical, on the other hand, are radically different; and that the mechanical conditions under which each best performs its functions are also very different." It thus appears that the words "capable of being put in vibration by the action of the electrical current" imply an adjustment that would practically incapacitate the instrument as a speech transmitter.

The learned counsel for the defendants have made a summary of the contents of the application which so completely covers that document as to negative any reasonable belief that Berliner's solicitor was mistaken in its preparation. There is no evidence that, in the description of the other inventions, the solicitor failed to express Berliner's meaning. The descriptions follow the caveats perfectly, and the claims follow the descriptions perfectly, except as to the transmitter of the caveat of April 14, 1877. Omitting that, the description and the claims are clear, complete and exact. The internal evidence of the application is all against the complainant.

Berliner testifies as to the preparation of the application, saying that he had made several distinct inventions and sought to save money by putting them into one application; that he had made one invention described in a caveat of March 29, 1877, for a system of magneto-telephony, which he did not believe valuable enough to include in the specification; that he intended to insert "first and principally, the invention consisting of a diaphragm in electrical contact with an opposite pin, by means of which I could send undulatory currents of electricity corresponding to sound-waves by decreasing and increasing the pressure between said diaphgram and said contact pin. This is described in the caveat filed by me April 14, 1877." This statement must be read with great caution. It was made in 1893, sixteen years after the event; after continuous controversy in the Patent Office, and when he is to be considered as an expert. His language is to be given no liberality of construction. If statements of intention made under these circumstances can be of any force as against a written statement under oath, to the contrary, yet this statement is insufficient on the ground that it does not meet the point. It is obvious from the specification itself that Berliner did intend to include the single-pin instrument and to employ "weakenings" as a part of his composite method for the transmission of musical sound. The inquiry is not as to whether Berliner intended to send undulatory currents, but whether he intended to send undulatory currents of the form requisite for speech by the single-pin instrument. In the argument for the Bell Telephone Co., 126 U. S. 299-309, Mr. Storrow, interpreting the Bell patent, clearly pointed out that speech is not a necessary result of an undulatory current; that undulatory currents may be used for musical transmission and other purposes. Berliner's evidence does not prove an intention to claim the single-pin instrument operating throughout its entire range of movement without break, to produce an undulatory current of the form requisite for speech. Before the Board of Appeal, counsel for Berliner argued, "Can it be discovered from any part of the (specification) that the inventor meant to employ variable pressure as an element? For if he meant to employ it at all, that is enough." Counsel also refer to "variable-pressure periods of transmission" with intermediate breaks. Berliner's testimony may mean only that he intended to send undulatory currents in periods between his intended breaks, or that he intended to send some undulatory currents having "nothing of the nature of each wave and the shape of their curves."

The argumentative character of Berliner's testimony will be observed upon reading it. It is entirely reasonable to suppose that Berliner, when he gave this testimony, was of opinion that he did intend to employ undulatory periods as a part of his method of operation in connection with the makes and breaks; and that he reasoned that, as he intended to employ these, he intended his instrument for the production of an undulatory current and was entitled, therefore, to credit for the general invention of an undulatory current transmitter which would include speech transmission, though he had not accomplished it. Though this is erroneous reasoning it was and is the reasoning of counsel and may fairly be attributed to Berliner.

Testimony as to an intention existing sixteen years before is of very slight weight at best, even when in direct and positive form; but when it may be based upon "interpretation" and is equivocal in expression, it can have no force against a sworn statement in writing.

It is claimed that mistake arose from speedy preparation by an incompetent solicitor's clerk, and because this clerk had difficulty in understanding

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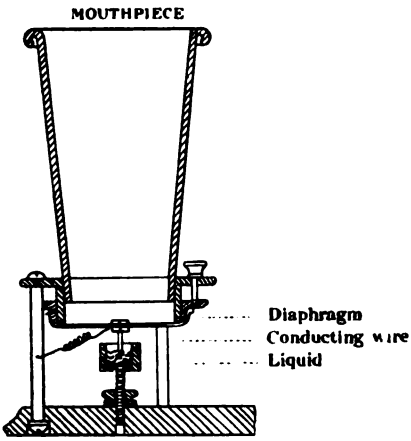
Berliner (who was a foreigner) on account of his imperfect accent. The charge that this statement appears in the specification through any fault of this clerk I believe to be unjust and untrue. It is certainly not proven. Berliner applied to a solicitor on May 13, 1877. His application was sworn to on June 2, 1877, and filed on June 4, 1877. He was turned over to Coombs, a clerk. Berliner says, "He made copious notes, and I remember giving him a few notes of mine." Coombs, the clerk who wrote the application, stated that he got explanations from Mr. Berliner previous to finishing the rough draft of the specifications; that they had an imperfect model or instrument, helped out with rough sketches and explanations; that at the time of drawing the specifications he had a general knowledge of electricity, but very little knowledge of speaking telephones; that Mr. Berliner's telephone was the first one he had ever seen or handled; that he found it rather difficult to understand Mr. Berliner on account of his imperfect pronunciation, and further "because the subject was strange to me."



BELL'S LIQUID TRANSMITTER 1876

BELL'S LIQUID TRANSMITTER.

The testimony as to the actual fact of mistake is remarkably meagre. Nor is it clear as to the amount of time spent in preparing the specification. Berliner testifies to a hurried examination of the rough draft of the specification, but that he did not read the final draft. That there was a mistake, we have no other evidence than the vague statement of Berliner. Coombs testifies to no mistake. There is evidence that Coombs was furnished with notes and explanations. No evidence is offered as to what those notes were, nor as to when they had been prepared. Berliner himself was not uneducated, but a man of intelligence and of unusual skill and facility in the use of language, and fully competent to have prepared complete instructions to Coombs. He had formerly written caveats by his own hand, viz., one of March 29, 1877, one of April 14, one of April 30, and one of May 9. In the summer or fall of 1877, he himself drew an application for patent No. 199,141, which is in perfectly good form, and conducted all the proceedings himself. The evidence as to speed in preparation of the application by a solicitor ignorant of the subject is evidence of the completeness of the instructions given by Berliner to Coombs. There is no evidence as to whether the caveats or copies were in the hands of the solicitor; but the application follows closely those caveats, and shows no error of Coombs in respect to any other invention. In fact, the only direct evidence of mistake is Berliner's own testimony.

Berliner does not testify that he instructed or informed Coombs that he had found that this instrument was capable of transmitting speech; nor does Coombs testify that there was any information offered to him as to the capabilities of the single-pin instrument for speech transmission. It certainly has not been made to appear that any mistake was made by Coombs in transcribing or putting into form any fact or statement communicated to him by Berliner. Coombs did his work thoroughly and accurately as to other inventions; presumably he did so as to this.

Berliner does not testify that he gave to his solicitor any documents inconsistent with the specification as filed. He does not state that any specific phrase in the document differs from what was stated by him to the solicitor. He does not state that he did not himself write or authorize the passage in question. He does not state that it was his intention to describe in his application a speech transmitter competent for the production of sounds without make and break. He is not called upon to deny categorically that any specific statement made in the specification was authorized by him. It was the duty of the complainant to prove in detail, and to the best of its ability, just what the mistake was, and how it occurred. Counsel say merely, Berliner was a German, his solicitor was incompetent, and application was hastily drawn and hastily read. They do not prove what the mistake was. They do not prove that Berliner did not fully authorize the statement that the instruments were not adapted to transmit speech. Expert interpretation is no substitute for testimony as to facts.

The oath of Berliner to his application completely overcomes his vague and uncorroborated oral evidence as to the actual fact of mistake. It would be contrary to the rules of law to allow a sworn statement to be swept aside by incomplete, loose and inconclusive evidence of this character offered by the party whose duty it was to produce all procurable evidence on this point. Berliner, however, has not only the burden of proving that mistake was made, but also the burden of accounting for his failure to discover it. If mistake was made it was on June 2. It was not discovered until August. We find, however, in the conduct of Berliner immediately after the filing of the application, evidence that this was no mistake. On June 27, more than three weeks after the filing of the application, an amendment was made relating to the double-pin circuit-breaker. On July 14 another amendment was made relative to the double-pin instrument and to the air discharge instrument; and on Aug. 8, 1877, the double-pin instrument was stricken out. From June 4 to Aug. 8 there stood on the files in the Patent Office a complete denial of the invention now claimed, and Berliner was examining and amending his specification in relation to the double-pin instrument, and during this period failed to discover any mistake. He attempts to account for this, saying that he had a badly copied letterpress copy of his specifications, "but in the course of time I would now and then, by fits and starts, pick up this letterpress copy, open its pages in a haphazard fashion, and then I would read passages of the specification in a manner. I would discover parts of passages which did not seem to sufficiently express all I meant to say and all I thought I had communicated to Mr Coombs. After discovering such deficiencies, I would go to Mr Norris's office and ask that the objectionable parts be amended or that additions be made, which was done by Mr. Norris. At another time this would be repeated. I would come across another passage which I thought needed amending, and I would again go to Mr Norris to have it amended; and in that way the number of amendments referred to is accounted for." Not one of the amendments made by Mr. Norris up to Aug. 8 bears this out. The first amendment of June 27, 1877, contains no corrections, but an additional description of his make-and-break double-pin instrument, and a new claim for the bent spring. The second amendment of July 14 substitutes the terms "spring made of metal" for the words "steel spring;" and there is contained an additional statement, not a correction, in reference to the air discharge instrument. On July 27, 1877, is another addition, and not a correction, concerning the air discharge instrument. No one of these actual amendments corroborates the testimony of Berliner that he discovered objectionable matter in the expressions of Coombs, and therefore made amendments.

These amendments, on the contrary, contradict his testimony. It is entirely improbable that these passages in the original draft could have escaped the attention of a man so skilful in the use of the English language, and so intelligent as Berliner; that he could have examined the document for the pur-

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pose of making the specific additions that he did make, and that he could have overlooked the denial of the very essence of the invention which he claims. If there is any degree of probability in this statement, the preponderance of probability is so strong against it that this evidence must be rejected upon the ground of its weak and inconclusive character upon the issue of mistake. He testifies that his first discovery of the error of the section dealing with the secondary pin, double make-and-break operation was in the early part of August, 1877; that, happening to pick up the copy of the specification, he immediately noticed "that Mr. Coombs had mixed the matter up considerably, and that the passages referred to did not express what I had invented; and, in fact, misrepresented it. At first, I thought I would amend this part of the specification so as to make it read right and convey the correct meaning such as I had laid it down myself in the caveat of May 9, 1877." He then testifies that he had by that time concluded that the double contact make-and-break instrument did not amount to much, and resolved to strike out the whole matter relating to it. It is apparent, however, that even then, when he learned of this vital error, he did not change the conception of the single-pin instrument operating as a transmitter by make and break, for his amendment of Aug. 8 still left the statement that the break or weakening of the electrical current was the method of transmitting sound.

Prior to any amendment in which, by any liberality of construction, we can find a constant-contact speech transmitter, there appeared the Philadelphia *Press* article, and Edison filed his application of July 20, 1877, for patent No. 474,231.

Assuming, however, that Berliner's testimony is to be interpreted as meaning that he did intend to describe and claim the single-pin instrument as a speech transmitter, it can have no force against his written statement unless corroborated by other evidence. Unfortunately for the complainant the only evidence in this case as to any success in experiments comes from Berliner himself. The two other witnesses produced to testify on this subject both say that at the experiments attended by them no speech was transmitted. Berliner testifies, however, to the presence of several other witnesses at other experiments, but the witnesses are not produced or accounted for. The testimony of these two witnesses is corroborative of the statement, made in the application that the simple instruments were not adapted to the transmission of speech; and the non-production of the other witnesses is a strong fact against the complainant.

We will consider, however, the contention of the complainant that, as a matter of fact, Berliner had made the invention before June 4, 1877. What did Berliner accomplish in speech transmission prior to June 4, 1877? He testified that he procured a copy of Bell's patent of March 7, 1876. "I studied his patent over and over again, and it became deeply impressed on my mind." A statement of the history of his invention was made by Berliner in Telephone Interferences, and was sworn to on April 12, 1879. In this he says that he commenced experiments in January, 1877. Being in a telegraph office, an operator explained to him the importance of pressing down the Morse key firmly in order to insure the prompt operation of the sounder; that it then occurred to him that, if a variation of contact pressure between the circuit-closing key and its rest could produce a variation in the current, then a varying pressure between the points of contact could be obtained by the vibration of one or both of them imparted to them by sound or sound-waves in the air in their neighborhood; that he constructed apparatus and proved by a galvanometer that changes of the current could be produced. He stated also that he made experiments on March 4, 1877; and that "a person at the receiver heard sounds when I spoke against the diaphragm of the transmitting apparatus, but could not generally make out the words I spoke;" also that, on April 12, 1877, using apparatus consisting of two single-pin instruments, "upon singing against the diaphragm of one of the instruments, the tunes could be heard distinctly at the other; and in speaking my voice would be recognized, and the persons listening said they understood what I said." He does not in this document, state that he himself heard the instrument transmit a word.

In 1893, fourteen years later, Berliner testified in the case brought by the Government for the cancellation of the patent, and gave the names of the persons present at the experiment of March 4, 1877, —Simon and Gustave Oppenheimer. Simon Oppenheimer testified concerning this experiment, saying:

"Berliner and my brother went upstairs, and I remained on the lower floor, and he first whistled into the instrument and I heard that — heard his whistling; and then he sang, and after trying that several times he tried talking. I could distinguish one from the other,—change of voice, but I could not make out any words."

Whether the witness means change in Berliner's voice, or change of voice from Berliner to his brother, is not clear. The other person present has not been produced or accounted for. The evidence of Oppenheimer throws light on the meaning of Berliner, when he says in his preliminary statement that a person could not generally make out the words that he spoke. Taking these statements together, the proof is that no words were heard on March 4, 1877. Berliner, in 1893, testified also to the experiment with two single-pin instruments in April, 1877, referred to in his preliminary statement. But a single experiment was made with this apparatus before the writing of the caveat of April 14, 1877. The preliminary statement and Berliner's evidence refer to this experiment though in the preliminary statement the date is given as April 12, while in the oral evidence it is given as April 11. The second single-pin instrument was first constructed on the 10th of April. He says:

"On the next morning before going to the store, I tried a practical experiment from my room to the room downstairs, and made the ladies of the house listen. They were very greatly surprised when I transmitted, as I always did for the purpose of amusing them, by means of interrupted currents; they heard the tunes loudly all over the room, and when I made them listen close to the apparatus and transmitted by variation of pressure, they reported to me much better results than they had previously heard at other experiments and they also thought that it was very wonderful indeed. They recognized my voice and got familiar sentences now and then. It was very difficult to adjust the apparatus. I had to run upstairs and downstairs continuously both for adjusting the transmitter and the receiver. The current would heat the contact, the plate would bulge off a little and get out of adjustment; but we did get quite good results. I immediately prepared, on the evening of the same day, a caveat describing what I did. I made a clean copy of my rough draft on the 12th, swore to it on the 13th, and filed it on the 14th."

He testifies, also, to a practical experiment, the date of which is not given:

"My listeners reported to me that when accidentally, as it happened very often in these experiments, the current was interrupted, they heard that familiar buzzing—the familiar musical sound they had heard before; that between such sounds, however, they heard a very faint sound, which they recognized as my voice, and that occasionally they thought they understood familiar words or sentences. I then went downstairs to listen for myself, and I found the same result when some one was speaking or singing upstairs."

He testifies that:

"I then for the first time noted the very great difference in the character of the sound emanating from the reproducer. The quality of tae sound when the current did not interrupt at the transmitter was that pure, human quality, sounding perfectly natural though very far off; but it was entirely different from the buzzing musical sound that had no admixture whatever of the quality of a human voice when the current was interrupted. I now and then thought I could make out the words of familiar sentences, but it was exceedingly faint."

He gives the names of persons who had listened at the instruments, namely, "Mrs. Gangewer, the lady I lived with; her daughter, at that time Miss Emma Gangewer; her son, Mr. Harry Gangewer; my room-mate, Mr. William Pribram; and two friends of mine, Mr. Simon and Gustave Oppenheimer, brothers." With the exception of Simon Oppenheimer, not one of these witnesses is produced, nor is the failure to produce these witnesses accounted for. A single other witness—Adolphus S. Solomons — testified that "I heard sounds which appeared to come from a violin; I felt sure I heard a violin playing." From his evidence it is apparent that Berliner endeavored to speak through his instruments; but the witness testifies that he told

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Berliner that he heard no speech, only some sort of a noise. The entire case as to experimental results in speech transmission rests upon the unsupported testimony of Berliner. As counsel says, there are occasions in the world when the paucity of proof in the affirmative is positive proof in the negative. Considering the great importance of establishing by other witnesses experimental results inconsistent with Berliner's express denial in his application, and the entire lack of any explanation of the absence of several witnesses who could testify upon this issue the presumption is justified that the testimony of these witnesses would be unfavorable to the complainant.

If a party has it peculiarly within his power to produce witnesses whose testimony would elucidate the transaction, the fact that he does not do it creates the presumption that the testimony, if produced, would be unfavorable. *Graves v. United States* 150 U. S. 118; *Runkle v. Burnham,* 153 U. S. 216-225; Clifton v. United States, 4 How. 242.

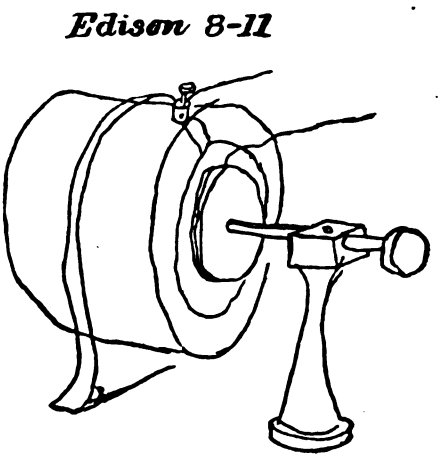
We should also consider the inherent dangers of oral proofs, when a witness undertakes to disprove former statements made by him in writing. In addition to this, the principles stated in *Barbed Wire Patent,* 143 U. S. 275, 284, 285, seem to be applicable to the testimony of Berliner, in view of the fact that his amendments were made after Edison's invention of a constant-contact speech transmitter, and after the Philadelphia *Press* article and the applications by Edison. Upon the whole evidence, I am of the opinion that, according to the strong preponderance of proofs, no one of Berliner's instruments ever transmitted a word of human speech under his manipulation; and that the only results that he ever got were such as are described in the application and attributed to the double-pin instrument. Professor Brackett testifies: "I have no doubt that, if he endeavored to transmit speech with the single-pin instrument of the application, which he refers to in the expression 'these simple instruments,' he found that they were not adapted for the transmission and reproduction of special sounds to be a fact. In this, his experience would not differ from that of every one who has attempted to transmit speech with the Reis and Regnault apparatus, which as apparatus is identical in principle and organization with that of the application." This was the fact with Edison, who rejected as useless what Berliner by his application rejected as useless. That a feat of experts has made that apparatus talk proves nothing as to Berliner.

The documentary evidence upon this point, to and including June 4, 1877, is the caveat of April 14, 1877; the caveat of April 30, 1877; the caveat of May 9, 1877; the application of June 4, 1877. The latter is by its character most important, being his latest statement of what he had done at the date of his application. This proves that he had not secured speech with the single-pin instruments; that he was seeking to secure speech by make and break of contact. It shows that he though that, by this method, with a double-pin instrument he had succeeded in reproducing "a great many special sounds, such as the vowels and others." The application overcomes the evidence as to experiment. Moreover, the fact that he was beyond all question attempting to get speech with a broken current renders it highly probable that he had not got it otherwise.

We will next consider the bearing of evidence as to the capacity of Berliner's instruments. It is proven in this record that Berliner's instruments, under proper conditions and manipulation and when properly adjusted, are capable of transmitting speech. It may be said that it is highly probable, if instruments constructed by Berliner will transmit speech, that he succeeded in doing so. This argument was presented to the Supreme Court concerning the instruments of Reis, 126 U. S. 193. It was there argued that to admit that the Reis instrument will speak now, and at the same time to deny that, with all his efforts to that end, the inventor made it speak in his time, had only boldness to commend it; nevertheless, the Supreme Court rejected this argument, found that he had not, and said, "The question is not whether the apparatus devised by Reis to give effect to his theory can be made, with our present knowledge, to transmit speech; but whether Reis had in his time found out the way of using it successfully for that purpose." *Telephone Cases,* 126 U. S. 539; *United Telephone Co.* v. *Harrison,* 20 Eng. Rul. Cases, 601. It is curious that the Reis apparatus should be asserted both against Bell and Edison upon the testimony of experts as to its capacity. The present question is not as to the operativeness of the machine. It is a question of Berliner's knowledge; of discovery. The burden is upon the complainant, if it relies upon the present capacity of the instrument as proof of Berliner's knowledge; of his discovery and of mistake, to show, not its present capacity in the hands of experts, but its capacity under the exact conditions under which Berliner was working.

Expert experimentation has disclosed the fact that the ordinary Morse key, the Reis transmitter, French nails and Berliner's instrument can be made to transmit speech under proper conditions and manipulation, but we cannot accept this evidence upon the issue of mistake for it is not proved that the experiments were conducted under similar conditions. It is a familiar rule of law that experiments, to be of value as evidence on such an issue, must have been made under circumstances similar to those constituting the premises from which the original event is alleged to have been the conclusion. 12 Am. & Eng. Enc. of Law, 2d Ed. Vol. 406; *Hawks* v. *Charlemont,* 110 Mass. 110; *Commonwealth* v. *Piper,* 120 Mass. 185; *Edit.* v. *Cutter,* 127 Mass. 522; *United Telephone Co.* v. *Harrison,* 20 Eng. Rul. Cases, 601.

The danger of this kind of evidence is apparent if we apply it to the double-pin instrument. Berliner was unable, according to his oral evidence as well as his statement in the application, to get speech with a double-pin instrument. Experts have succeeded in doing so, and Professor Wright testifies that, properly adjusted, the second pin "somewhat extends the range of voice intensity for which the instrument can be used;" but this does not disprove Berliner's testimony as to his failure with a double-pin instrument. In like manner, the success of experts with the single-pin instrument does not disprove the statement made by Berliner in his application.



FEBRUARY 9, 1877.

EDISON TRANSMITTER.

The complainant, if it desired this evidence to be accepted as evidence of mistake or of Berliner's knowledge, should have proved and called to the Court's attention proof of the exact conditions existing at Berliner's experiments; it should then have proved that similar conditions were created in the experiments of experts, and that then the result accorded with Berliner's testimony. Anything short of this is not competent legal evidence to sustain the burden of proof as to mistake, though it might be were the issue merely as to operativeness. The question is not as to the capacity of the instrument, but of its actual performance at a certain time. Berliner's experiments in speech transmission with an instrument having an iron diaphragm were conducted hastily on the morning of April 11, before he went to the store. It is in evidence that he was accustomed to go to the store at half-past seven in

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the morning. For the first time he had coupled together two single-pin instruments; and this experiment was the first exhibition of his new receiver. He was embarrassed not only by the difficulties of adjusting his transmitter, but with the difficulties of adjusting for the first time his new receiver.

It is to be noticed that there is no evidence of results between April 14 and June 4, 1877. In determining the probability of successful results in speech transmission at this experiment, we should consider also the circumstances immediately preceding the filing of the caveat of April 14, which clearly show that it was based principally upon what he considered a new phenomenon. On the 8th of April occurred a dramatic and impressive incident, in consequence of which Berliner states, "I became much agitated." On the 8th of April, six days before filing the caveat, late in the evening, he had connected the instrument to the galvanometer, and was connecting two terminal wires for the purpose of closing the circuit.

"It was exceedingly quiet about the house and on the street. In closing the circuit I suddenly heard a noise coming from the diaphragm, which surprised me very greatly. I thought I had mistaken my ears, but on repeatedly making and breaking the circuit, a distinct and sometimes loud tick came from the diaphragm and apparently from the point of contact between the diaphragm and the steel ball. That was entirely new to me, and I became much agitated, because I saw immediately that I had here a new acoustic phenomenon, viz.: that sound was produced without the aid of electrical magnetism, merely by the current itself. I quickly took the tuning-fork which I had in my possession; I wound one of the wire terminals around the shank of the tuning-fork, struck the same on the table, and applied the vibrating prongs to the other terminals of the line. Immediately a loud musical sound corresponding in pitch to the sound of the tuning-fork came from the iron diaphragm. I knew at that moment that I had made an important addition to my observations, for I quickly perceived that if the diaphragm could give out a musical sound it could also reproduce speech when, instead of an interrupted current, an undulatory one was sent to affect it."

This was the first conception of his receiver—a new and distinct invention by which, using the language of his application of June 4, he could effect the object of producing by a common galvanic current "marked mechanical effects that will be distinctly demonstrated to the observer." Here, then, was a new invention; one not exhibited before, and which was first exhibited to others on the eleventh day of April. From that time he experimented only with his new receiver in connection with his transmitter.

It is in evidence that the adjustment of the transmitter and receiver is quite different.

In the experiments made by the experts it appears that the adjustments were delicate. It further appears that, for the successful transmission of speech, there is a very narrow range in the movements of the electrodes.

Professor Wright has testified that, "When transmitting speech, the electrodes of the microphonic transmitter are brought together with a pressure which is very light, and which has been determined by experiments to vary within a comparatively narrow range." The evidence shows clearly Berliner's readiness in applying for caveats upon hasty experimentation. His caveat of April 14, for the two instruments coupled together, was based upon a single experiment in which his attention was in all probability chiefly engaged in exhibiting the marked mechanical effects that he had discovered how to produce by his new receiver, and which seem to have been the chief incentive to the filing of the application of June 4. The evidence accords with the views of the defendants' counsel, that claims 1 and 2 of the original application were merely for a receiver.

The complainant contends that Berliner's invention did not reside in structure; that he reproduced substantially the old Reis apparatus, which can be operated either to break the current or to preserve it unbroken. His invention is said to be a new mode of operation. Proof that he reproduced the old apparatus does not prove that he discovered the practicability of a new mode of operation. He is not entitled as an inventor of apparatus to claim whatever may be found to be within its capacity, because his sole claim to invention is based upon an alleged discovery of a new capacity in old apparatus. If he did not discover this, nothing new remains that he did invent or discover. He did not "embody" an invention in a machine until he succeeded in making the machine perform Bell's process upon the current. He no more made the invention by making the machine than did Reis or Morse.

Upon the question of mistake and of the right to amend, we have finally, Berliner's caveat of April 14, 1877. This document is the chief reliance of the complainant. It may be said that it is practically the complainant's case. It is presented as evidence of mistake in the application; the argument as to the right to amend is based chiefly upon it; it is also contended that it counts as a full reduction to practice. We have to consider two distinct contentions; first, that it is evidence that the application stated what Berliner did not intend to state — a question of mistake; second, that by writing this caveat Berliner had completed and reduced to practice the invention of a speech transmitter "even if he had not known that he could transmit speech, or even if he had believed that he could not." This remarkable contention raises a question as to the effect of erroneous opinion, rather than a question of mistake. If Berliner was an inventor of a single-pin speech transmitter in spite of his belief on June 4, 1877, to the contrary, this would not have prevented him from making the statement that his instrument could not transmit speech, nor would this aid the complainant in showing that he intended to apply for a constant-contact speech transmitter. An invention which the applicant had not intended to include could not be introduced by amendment upon a change of intention.

Is the caveat inconsistent with the statement in the application upon a comparison of the two documents? The earlier, from its nature, "does not purport to be an account of a result accomplished, but of a result expected and desired." Robinson on Patents, Section 448. The latter purports to be a description of a completed invention, the expression of the matured and final opinion of the inventor. This caveat proves that on April 14, 1877, Berliner intended to use the instrument of the patent to alternately weaken and strengthen the current. The patent in suit follows closely the language of this caveat, though it differs in essential particulars. We may assume that it proves intention, and a project existing on April 14, 1877. The existence of this intention on April 14 is some evidence of the existence of a like intention on June 4. As a matter of fact, however, the document is not conclusive upon the question of constant contact of electrodes. "It does not state that the transmission of the electric force is to be made through a closed circuit, although this . . . is really the principle on which a successful working invention depends." See *United Telephone Co.* v. *McLean*, 20, Eng. Rul. Cases, 587. Though it says that the current is to be strengthened and weakened, it does not expressly state that the current must not be broken, but says:

"Part 6. If the uttered sound is so strong that its vibrations will cause a breaking of the current at the point or points of contact in the transmitter, then the result at the receiving instrument will be a tone much louder, but not as distinct in regard to articulation."

The document affords no evidence of the amount of experimental basis for this statement, or whether it was based largely upon theoretical considerations. It would be obvious, perhaps, that a broken contact could not produce with the same accuracy as an unbroken contact sound-waves impressed upon the diaphragm; though it would not be so obvious that the louder and more audible effects were useless for speech transmission, and must be rejected. Had Berliner succeeded in transmitting speech by a composite operation of weakenings and breaks, that method could have been found in the caveat, which refers to a tone "much louder, though not as distinct, in regard to articulation," produced by a broken current. In the brief filed before the Commissioner on appeal from the primary examiner's rejection, it was stated by Berliner's counsel in reference to this language that "Berliner knew that any break would injure articulation, though there might, he thought, be some breaks which would not absolutely destroy it." This interpretation by Ber-

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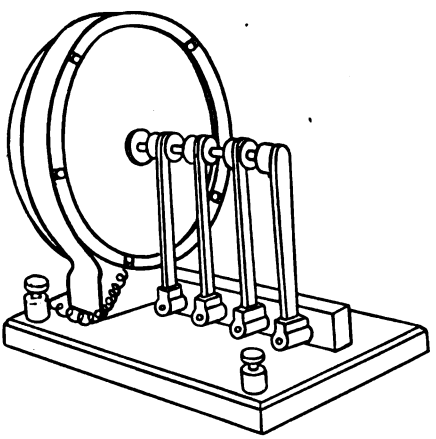
liner's former counsel is much fairer than that of Professor Cross—"The caveat also states that under strong sounds the transmitter would break the current; but that in so far as it broke, it would be useless for the transmission of speech." This is unwarranted. The caveat, therefore, does not prove that Berliner had learned that the breaks of contact were inadmissible, produced no articulation, and must form no part of the intended operation, and that in speech transmission he must discard his most conspicuous receiver effects; but suggests a doubt upon this subject. This doubt apparently ripened into an erroneous opinion as the result of experiments which led to the caveat of May 9, and to the double-pin instrument of the application of June 4, 1877. Whatever was his intention or opinion on April 14, the document of that date does not displace the statement in the application of June 4. They are reconcilable on the view that the caveat was the expression of a project formed after hasty experiments which showed only a few variations of current; not Bell's speaking current.

But this document does not stand alone. It is merely one of several documents; and it is the general rule that later expressions are of greater force than earlier. We must consider, in connection with the caveat, not only the application, but the other caveats of April 30, 1877, for a circuit breaker, and of May 9, for a circuit breaker. Berliner's model filed June 4 was based upon this caveat of May 9; and the application for a speech transmitter follows this caveat. Previous to June 4, then, we have as evidence of Berliner's intention and affecting the question of mistake, three documents; the first, showing an intention to use a weakening and strengthening of the current, but suggesting a doubt as to a breaking of the current, the other two showing most conclusively that between April 14 and June 4 Berliner intended to utilize a broken current. He testified also that, immediately before the preparation of his caveat of May 9, he thought that he "had a phenomenon which apparently was different from Mr. Bell's conception of what an interrupted current might do, namely, since he said that an interrupted current could only produce pitch, while I had here something more than pitch, something of the combination and quality of sound." It was, of course, desirable to use an interrupted current, if possible, and thus avoid Bell's patent. The preponderance of documentary proof, as to intention on June 4, would overcome the caveat of April 14, even if we should regard it as complete evidence of Berliner's intention on that date to preserve constant contact of electrodes. We have also, in addition to the evidence of Berliner's intention prior to June 4, proof of an intention similar to that expressed in the application existing long after that date. The amendment of Aug. 8 left the description of a composite operation of breaks and weakenings of the electrical current still remaining. The erasure, in connection with the fact that his attention had been called to the matter and that he did not change his statement, is evidence that Berliner, on Aug. 8, did not intend constant contact as his normal mode of operation.

In his oral testimony he states that he thought that he had discovered greater capacity in a broken current than Bell attributed to it. In September, 1877, he issued a circular or memorandum to his co-laborers in science, describing his single-pin instrument, saying, "Any vibration of sound striking one of the plates will either weaken or interrupt the point of contact, and thereby the current, and will thus cause the other plate to vibrate in unison with the first, reproducing the same sound." In his substitute specification, filed in the Patent Office Oct. 27, 1877, he claimed a circuit breaker; and in a subsequent patent, No. 199,141, written by himself and applied for Oct. 16, 1877, he stated, concerning his application of June 4, 1877: "The transmission was made by either breaking the contact or by alternately weakening and strengthening the same at each vibration of sound affecting the plate. The reproduction of sound was effected by permitting such a current thus consisting of electric waves to pass through a similar receiving instrument . . ."

The intention expressed in the application, therefore, existed long after Aug. 8. It is certainly more probable, also, that Berliner intended to follow the later caveat of May 9 than the earlier caveat of April 14, for the instrument of the caveat of May 9, and of the application, has all the capacity of the single-pin instrument as well as such additional capacity as results from the addition of the second pin. As evidence of Berliner's accomplishment, the caveat is of slight value. It proves what he was trying to do. It does not prove that he had by experiment secured such an adjustment of his apparatus as enabled him to secure results inconsistent with what is set forth in his application of June 4, 1877. Counsel urge that "even in the double-pin instrument (of the caveat of May 9, 1877) which did make and break, the dominating principle was after all, as far as possible, to keep the contact, and to keep it in such a way as to vary the pressure so that even if there is an intermediate break, yet it is a break which is intermediate only, and takes place, if at all, only between two variable pressure periods of transmission."

This is inconsistent with the complainant's brief, but if this be true, we have strong evidence that Berliner abandoned the intention of April 14. Berliner states in his application of June 4 what he could accomplish with the double-pin instrument: "I have thus succeeded in reproducing a great many special sounds, such as the vowels and others." If it be said that this refers to the make-and-break method, we may refer to his oral testimony: "I continued to experiment with this apparatus for a few days, but could not possibly get anything else but these three vowel sounds, and generally only two, and nothing at all of consonants."



EDISON TRANSMITTER. APRIL 1, 1877.

This caveat was filed May 9. Prior to May 13 he had consulted a solicitor, and had a model made at his request which he took to his solicitor on May 13. This model embodied both his single-pin instrument and his double-pin instrument. A certified copy of this model will transmit speech in the hands of experts. Will it now be said that Berliner's failure with a double-pin instrument was because its dominating idea was to make and break? This is inconsistent with the views of counsel on final argument. The simple fact, according to all probability, is that Berliner spoke to his double-pin instrument, adjusted it the best he could in the light of all he knew as to the capacity of the single-pin instrument, and "thus succeeded in reproducing a great many special sounds, such as the vowels and others," which he attributed to the second pin.

With this apparatus he had got more than with his single-pin apparatus, probably for the reason that under expert handling, the best operation of the instrument is when the contact is so weak that breaks are likely to occur with great frequency, and render the instrument impracticable for commercial use. His first approximation to speech was when he attempted to break his current and make contact with the second pin. Berliner, therefore, after experiment, arrived at the conclusion that his single-pin instruments were incapable of transmitting speech. He formulated clear and definite reasons for this opinion. He stated these clearly to his solicitor, who expressed them clearly according to his instructions. He also told his solicitor all that he had accomplished with the double-pin instrument, a

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drawing was made showing this double-pin instrument, provided with a speaking tube and an ear tube, and the solicitor clearly stated all that Berliner had accomplished; this was his best result. The application of June 4 clearly represents his last opinion, and shows conclusively that he had produced no experimental results to the contrary.

Even had this caveat made the express statement, "I have succeeded in transmitting the quality of sound, and I think I have obtained some words," the sworn statement in his application would not be inconsistent with the caveat. It would simply prove the insignificance of his results. There is no difficulty nor improbability in the supposition that, after the full preparation of his caveat, Berliner still had to ask himself the question, "Will it work?" It is in accordance with all the probabilities, with the experience of Reis and of Edison, that he found that it would not.

The complainant next contends that whatever may have been Berliner's opinion as to the capacity of the instrument, and even if he thought he knew that the instrument would not transmit speech, he had yet made the invention of the patent in suit because the caveat is a complete reduction to practice. As we have already observed, this would still be insufficient; for, in order to amend, he must both have made the invention and have intended to apply for it. But, as the contention may be renewed, it may be well to consider it. The contention that the caveat of April 14, 1877, counts as a full reduction to practice, irrespective of experimental results, is equivalent to a claim that, had Berliner stated in writing simply, "Reis's instrument operated by the Bell method will transmit any and all sounds," this constituted a complete reduction to practice, even were Berliner ignorant of the truth of his statement. There is inconsistency between this contention and the claim that there was invention in operating the Berliner-Reis instrument by Bell's method. If it was obvious, upon a reading of Bell's patent, and upon learning the capacities of an undulatory current, that the Reis instrument could be so operated as to produce Bell's undulatory current, then there would have been no invention in using the old method with an old instrument. The Supreme Court in 126 U. S., page 545, said, concerning Van der Weyde:

"It is only necessary to say that he copied Reis, and it was not until after Bell's success that he found out how to use a Reis instrument so as to make it transmit speech. Bell taught him what to do to accomplish that purpose."

This raises a doubt whether the mere discovery that the Berliner-Reis instrument could be operated by the Bell method constituted a patentable invention. The Supreme Court also said, "With the help of Bell's later discoveries in 1875, we know now why he (Reis) failed." "It was left for Bell to discover that the failure was due, not to workmanship, but to the principle which was adopted as the basis of what had to be done." The argument that the caveat is a full reduction to practice, irrespective of experimental results, is based upon the assumption that Berliner, as an inventor must have realized that what he had written down was necessarily true. If so, patentability must be denied on the ground that the caveat was a simple following of Bell. Mr. Storrow argued (126 U. S. 288), as to the operativeness of the Reis apparatus:

"If this were true it would only show the perfection and the novelty of Bell's new method or mode of operation, which, when applied, would enable that which never had been a speaking telephone, to at once transmit speech."

There is force in this argument. The complainant's case as to invention, however, is based upon the contrary assumption and upon proofs to the contrary.

Professor Cross says:

"There was certainly no reason to justify a scientific man in asserting that, under the slight change of pressure due to the voice, the variations of resistance correspond to and are approximately proportional to the variations of pressure, and are great enough to yield practical results. This," he says, "was not wholly unknown, but what was known on the subject tended to show that the operation expressed by this law was an impossibility."

How can it be claimed, then, that, aside from experimental results, a mere statement in writing, which was upon its face a statement of something that could be known only empirically, is equivalent to complete invention? Professor Wright says:

"There is another principle which is utilized in the case of any microphonic transmitter transmitting speech, and that is the proportionality between the variations in the current strength and the variations in the pressure at the point of contact produced by the vibrations of the air caused by articulate speech or other sound. So far as I am aware, this principle of proportionality was not known and had not been utilized for any practical purpose before the time of Berliner's invention described in his caveat."

The contention that the caveat establishes invention because in some cases invention may be established by drawings and verbal descriptions fails to recognize the distinction between inventions dependent upon familiar facts or familiar mechanical principles, and an experimental invention based on the discovery of new facts. A drawing or words may or may not prove completed invention, according to the subject-matter. If common persons guided by common knowledge, or experts, or scientific men, guided by scientific knowledge, can say, upon reading text or examining a drawing, "this will necessarily work, it accords with what is known," then there may be a reduction to practice by a drawing or by a verbal description.

If, upon reading a document or studying a drawing, scientific men and experts would say, "all that is known tends to show that this is an impossibility, or there is nothing in common experience or in expert or scientific knowledge which justifies this statement without experiment,"— if it will not be believed without experimental verification,— there surely is not patentable invention in the writing down of the project. It is a bare hypothesis. The contention is based upon a quotation from the *Telephone Cases*, 126 U. S. 536:

"The law does not require that a discoveror or inventor, in order to get a patent for a process, must have succeeded in bringing his art to the highest degree of perfection. It is enough if he describes his method with sufficient clearness and precision to enable those skilled in the matter to understand what the process is, and if he points out some practicable way of putting it into operation."

As the Supreme Court held that Bell's description of a process of treating an electrical current was sufficient to sustain his patent, though Bell had not transmitted speech prior to the date of his application, the complainant seeks to place Berliner on a par with Bell as the inventor of an art or process, and thus to avoid by the caveat the effect of the denial in the application and the imperfection of the evidence as to experiments. But there is no analogy between Berliner's secret caveat of April 14, 1877, and Bell's specification.

Bell made a most remarkable primary invention, and described exactly a process based upon a scientific conception — "a mathematical conception." 126 U. S. 539. His patent was "not to be confined to the mere means he improvised to prove the reality of his conception." The Berliner caveat does not purport to describe and does not describe a new process of treating a current, but upon the most favorable construction merely apparatus for practising Bell's art,— novel not as structure, but as an old structure applied to a new use. A structure that had failed as a speech transmitter under the efforts of Reis, Edison and others. It states that the pressure between the plate and the metal ball can be regulated by a thumb screw, but the success of the apparatus is dependent upon the operator's finding out for himself the exact adjustment of each instrument. It is clearly shown by the evidence that to obtain the exact adjustment and conditions necessary for the transmitter is a matter requiring great care and skill, and that the adjustment that is essential for the transmitter is unsuitable for the receiver. If this caveat is now a direction sufficient to a person skilled in the art, Berliner was not so skilled,— but an uninformed experimenter. The caveat may be followed as far as its directions go without success. A feat of experts must be added to what is shown. Professor Cross says:

"With every microphone there is a certain 'normal pressure' as it is called, which should exist between the electrodes when at rest, in order to secure good microphonic action. . . . It is a well-known fact that the electrodes of an ordinary microphone transmitter will not operate to transmit speech if they are closely clamped together."

Professor Wright says:

"When transmitting speech, the electrodes of the microphonic transmitter are brought together with a pressure that is very slight, and which has been

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determined by experiment to vary within a comparatively narrow range." He says, also: "I have ascertained by numerous experiments made with a great variety of microphonic joints that with all combinations which are ever practically used in transmitting microphones, there is a certain interval between the smallest pressure and the largest pressure practicable, within which the changes in the intensity of the current are very closely approximate to the changes in the pressure which produce them."

We have already referred to the evidence of Professor Wright, "that the mechanical conditions under which each best performs its functions are also very different." The caveat discloses nothing of all this, it does not prove that Berliner had found out the "certain interval between the smallest pressure and largest pressure practicable" for his transmitter, nor the suitable adjustment for his receiver. It affords less evidence, even, than his oral testimony, and certainly cannot mean anything more. Therefore, when we find that his caveat was based upon a single experiment with the two instruments; that he afterwards made the double-pin instrument and applied for a patent upon it, and declared the uselessness of his caveat transmitter, it becomes necessary to conclude that Berliner, as a matter of fact, did not accomplish what he hoped to accomplish; that he stopped where Reis did. And, in the face of such a conclusion of fact, there is no artificial rule of law that makes Berliner's caveat description a reduction to practice. It is merely a part of the evidence, one of several documents all equally relevant. In *United Telephone Co.* v. *Harrison*, 20 Eng. Rul. Cases, 602, it was said:

"How can we, dealing with a subject like electricity (a subject which at the present moment is so obscure that I am not sure that scientific men would pledge themselves now to the exact way in which the transmitter works), and going back six years into the twilight of the discovery, say that an instrument which presents no means of knowing what the best adjustment was, is the same instrument as that which does."

How can we say that Berliner's caveat, which shows substantially the Reis apparatus and does not show what experts say is essential to make it transmit speech, is the equivalent of a reduction to practice? The evidence of the experts as to the absolute necessity for a loose contact accurately adjusted seems to establish the insufficiency of Berliner's caveat to prove that he had discovered any of "the remarkable properties of a loose joint."

So far as efficiency and difference in electrical effects are concerned, the caveat is silent. Berliner's problem, after receiving from the Morse key a suggestion, and after finding by galvanometer tests that a variation of current could be produced, was still before him. He had no theoretical grounds whatsoever upon which he could state anything more than that some variation of the current might follow.

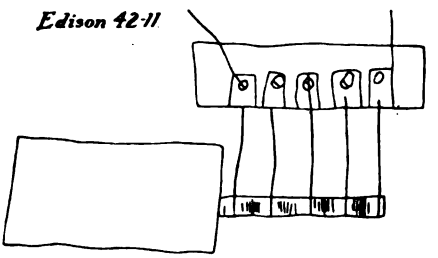
Upon the evidence of complainant's experts, it was a known fact that changing the firmness of contact of solid electrodes would change a current, and the problem was to find whether it could be changed in a sufficient and proportional amount by the vibration of a diaphragm. If Berliner did not by experiment discover this his pretensions are baseless. Berliner's invention, if he made one, lay in experiment. He was entitled to formulate an expression of what he had found out by his experiments. He was not entitled, either scientifically or legally, to lay a claim to anything more. It was necessary, before the forecast expressed in the caveat was entitled to be called a conception from which invention could date, that Berliner should have found not only that he could produce some variations of a current, that he could get something of the quality of speech,—but that he should have produced substantial effects that were a demonstration to the ear of the truth of his project. Edison had changed a current with a Reis instrument and produced audible effects in 1876; Edison's attempt to operate a Reis transmitter without breaking the current anticipates Berliner's conception, and he had demonstrated that a current could be changed. If this is all Berliner did, if this is all the caveat proves, he is anticipated by Edison's experiments with the Reis transmitter.

In Robinson on Patents, Sect. 381, referring to inventions which are the result of experiment, it is said:

"The production of a new means by this method is . . . . an inventive act, but at no instant before the experiment succeeds can it be said that the conception of the invention exists in the inventor's mind. Until that instant, it is mere speculation, as a probable deduction from facts already known; and the same act which reduces it to practice gives to the conception its definite and final form."

This I believe to be sound. One who should read this caveat would find in it nothing self-evidently true or conformable to experience. He would be obliged to take the author's word for it as a statement of fact resting on authority. Counsel contend that the belief of Berliner that he could not transmit speech would make no difference. They say:

"He had invented, described and pointed out a mode of operation, a method of varying resistance in the circuit by varying pressure, which necessarily does result in a capacity to transmit speech. It is not the mere fact that speech is transmitted, which is the thing that is claimed in this patent. It is the discovery and invention of a method of varying resistance in a circuit which is of supreme value, because, whether known to the inventor or not, it will transmit speech and all other sounds, and will necessarily mold a battery current as is necessary to mold it to transmit speech."



EDISON TRANSMITTER.

Here counsel are claiming for Berliner what Bell's patent claim 4 covers completely. The only method of varying resistance, whatever its kind, is Bell's—to vary it by and proportionately to the pressure exerted by sound waves. Berliner, of course, knew what Bell's undulatory current could do if he could produce it,—his problem was either to produce it or to approximate it by a composite operation of breaks and weakenings; but he did not know, merely because he could produce deflection of a galvanometer, or something of quality, that he could produce Bell's speaking current (see 126 U. S. 299, 302, 303) any more than Reis did. It is here contended, practically, that if Berliner found out that, by pressing together two electrodes, he could change a current, he was entitled to leap to the conclusion that he could produce any and all changes of a current; that he could vary it in the required proportions, and that upon this he became entitled to lay tribute upon all practical experimenters. But the patent law affords no protection to speculators nor to prophets. If the conclusions of fact are sound, and Berliner's caveat—as upon the evidence I am forced to believe—was merely a clever hypothesis reduced to text and drawings, no case could present a more forcible example than this of the necessity of drawing the line between the speculator and the inventor. A failure to draw this distinction, and the apparent failure in the Patent Office to give to the caveat of May 9 the same force as evidence as that of April 14, together with the acceptance of insufficient evidence of mistake, has led to the conversion of an abandoned scheme into a patent that has for ten years been asserted unjustly against the public right. Edison by countless experiments succeeded in advancing the art. Berliner's secret caveat would never have given the world a speech transmitter. It was embryonic, inchoate, and rested in speculation. Because of his application of June 4, 1877, the authorities that the complainant's brief quotes against Edison are applicable with full force to Berliner and his caveat when it is resurrected and asserted adversely to Edison.

"The law requires not conjecture, but certainty." *Coffin* v. *Ogden*, 18 Wall. 124.

As skill in language and in scientific method becomes more common, it is easier for speculators to

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survey and cover the field opened by new discoveries; it is easier to generalize as to what may be done, and to mark out the general lines upon which progress must be made, than to accomplish practical results. But the work of practical men should not be hampered by finding a new, useful and practical device covered by some patentee who was able to make generalizations applicable to all that might be developed within seventeen years from the date of a paper patent. It surely was not the intention of the Supreme Court to decide, and the Supreme Court did not decide, that he who guesses is an inventor if he writes down in a secret memorandum clever guesses or projects which are verified by others. If this is the correct interpretation of the decision, the speculator has only to make broad and expansive generalization, and await the issue of the necessary labors of practical experimenters. If their efforts fail, he has lost his paper and ink. If their efforts succeed, he may exact tribute from those whose efforts have led to practical results.

The complainant's attempt to base the case upon this caveat, irrespective of Berliner's experimental results, involves it in a curious situation. Professor Cross says, in effect, that what was known on the subject tended to show that what Berliner wrote in his caveat was an impossibility. Counsel says it was "an invention until it had been accomplished, of incredible character." It is said that the invention was based upon Berliner's discovery of the availibility of solid electrodes to effectively vary the current in the required way. By writing the caveat regardless of what he knew experimentally, Berliner made an invention because what he wrote was true in fact, and therefore necessarily true at the time it was written down. Although on its face an apparent impossibility. Berliner must have realized that what he wrote was true, even if he did not make the experimental discovery. That even if at a later time he became convinced that what he wrote was an impossibility, as it appeared on its face to be, and stated in his application that it was an impossibility, he was an inventor because other persons have made the discovery that his later statement was untrue and that his first statement was true, and therefore he was entitled to amend his application by striking out the major part of it, and inserting large portions of his caveat. To make a case, even upon such an argument, it must go one step farther and say that he might amend even if, at the time of making the application, he had not intended to claim what was in his caveat.

The real question is not whether this caveat would have been good as an application for this patent, but whether, as a matter of fact, Berliner had made any discoveries that render it probable that his application stated what he did not intend to state, or that he intended to claim his single-pin instrument for speech transmission. As we have said, if there is an artificial rule of law that makes this caveat an invention, though Berliner did not know it, there is no artificial rule of law that attributes to him an intention to make an application for a speech transmitter when he was of the opinion that he had not invented one. Therefore, the contention that the caveat is a reduction to practice, if established, would be insufficient to support the complainant's case.

When Berliner filed his application, he left it open to others to discover that speech could be transmitted with a diaphragm and a metal pin. The expert who first succeeded in doing so is entitled to the credit of making that discovery despite Berliner's caveat. The case cannot, upon any view, be maintained without proof of experimental success. I am of the opinion that this proof is necessary in order to establish invention; but, if this is not so, I think that there can be no doubt that it is nevertheless still absolutely necessary in order to show that Berliner, on June 4, 1877, intended to make application for what is covered by the patent in suit.

Even after the mind had been conciliated by the course of argument adopted in the complainant's brief, and if a comparison of Berliner's original application and his patent is preceded by the detailed statement of all the circumstances favorable to Berliner, and the argument of experts upon his application, yet, after all this, the conscience is shocked when Berliner's application and his patent are compared; and a shock to the intelligence also occurs when we are told that the clear, specific and detailed statements of Berliner's application were mistakes of a solicitor's clerk, who was ignorant of the subject, and therefore must have got all his information from Berliner.

The patent, then, is invalid: First upon the ground that it issued for an invention which Berliner had not made at the time of the application; and, second, upon the distinct ground that it issued for an invention not disclosed by or claimed in the original application, and not incorporated into it by legal amendments.

The next question affecting the validity of the complainant's title is the defendant's point that the patent in suit is void because of Berliner's earlier patent No. 233,969, of Nov. 2, 1880. This is known as the Receiver Patent, and was issued upon a division of the original application. It contains a sufficient description of the transmitter to sustain a claim if Berliner were seeking it. Counsel for the complainant concede this. It is sufficient to consider claim 4.

"Claim 4. A system of two or more telephone instruments in electrical connection with each other, each consisting of two or more poles of an electrical circuit in contact one with the other, either or both poles of each instrument being connected with a vibratory plate so that any vibration which is made at one contact is reproduced at the other, substantially as set forth."

This claim is for two single-pin instruments in a system. Each is a relative part designed for and only useful in a system. They are system parts or relative instruments. In the system, each performs its whole function, and alternately the functions are reversed. We find, therefore, in this claim, the transmitter performing its entire function of producing electrical undulations similar in form to sound-waves, and applied to its appropriate use in connection with a receiver. This claim embodies the transmitter completely. Its intended function is in no way modified by the fact that it is united with a particular receiver. It performs with this receiver the same function as with any other receiver. The complainant contends that this claim is for a combination which is an invention distinct from either the transmitter invention or the receiver invention. I am of the opinion that this contention is unsound. As the transmitter is a system part or relative part, it is used in patent law, to put the system part into a system for which it is designed; to put a relative instrument into its intended relation. This is but application to appropriate use. No third person would have been entitled to a patent for a combination by uniting two of these instruments. There is no invention over and above that which is in the transmitter and that which is in the receiver. A "transmitter" implies a receiver, a "receiver" a transmitter.

The fourth claim, nevertheless, is not invalid, because Berliner was the inventor, we may assume, of both; and he might take a patent with such limitation upon the use on either as he saw fit. He could not, however, take a patent for his transmitter limited to its appropriate use with a single receiver, and subsequently take out a patent that would enable him to control any and all uses of the transmitter, since the latter patent would include the former use, for which he had already received a patent. It is a valid claim, because as we may assume for this argument, the elements were novel, and Berliner was the inventor of both. The claim confers a monopoly of the transmitter with a restriction or limitation. The patent in suit confers a monopoly without restriction. The patents are, nevertheless, both for the "same invention," both in a legal and a practical sense. It presents the familiar case of an inventor taking a patent with an unnecessary limitation. The commissioner has exhausted his power and cannot afterwards give him a general grant for all uses. The argument that the use of the transmitter or of the receiver alone would not infringe claim 4 is immaterial; it does not prove that the claim is for a third invention, but merely that the claim does not cover all the uses which might have been covered, had the patentee not chosen to take a claim for a restricted use.

That the two patents are not co-extensive does not affect the application of the rule against double patenting. The patent of 1880 gives Berliner full protection for his transmitter in a particular application to an appropriate use. It is said that in electrical apparatus the word "system" has just the same meaning as the word "combination" in purely mechanical apparatus. Berliner's 1880 specification does not, however, disclose any invention in the

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coupling of his instruments, but merely elements united without invention. In *Palmer* v. *Brown Mfg. Co.*, 84 Fed. Rep., page 454, it was held that a claim purporting to be for a combination was, in fact, simply for an application to an appropriate use of what was claimed in an earlier patent, without the development of the inventive faculty in making the application. Though the Circuit Court of Appeals disagreed with the Circuit Court upon the question of whether or not there was a true combination, and sustained the patent on the ground that there was a true combination, it said, "The test of identity afforded by a comparison of the claims of the two patents, however, is not conclusive. We must be satisfied further that there are substantial differences, not merely varying descriptions of one invention, or descriptions of a single invention in different applications to use." There was no disagreement with the views of the Circuit Court upon the legal proposition that, where the difference between two patents was that one was for a specific device and the other for a specific device applied to its appropriate and intended use, the patents were for the same invention. *Palmer v. Brown Mfg. Co.*, 92 Fed. Rep. 925. See also *Palmer Pneumatic Tire Co.* v. *Lozier*, 90 Fed. Rep. 732. That the claim also covers the instrument when performing its functions as a receiver is immaterial. The reference in the 1880 patent to the application for the patent in suit, if intended as a reservation, does not avail.

Miller v. *Eagle Mfg. Co.*, 151 U. S. 186, 192, 201. *Palmer Pneumatic Tire Co.* v. *Lozier*, 90 Fed. Rep. 745.

Without considering other grounds based upon other claims of the 1880 patent, I am of the opinion that, by granting claim 4, the Commissioner exhausted the power to issue the patent in suit.

I agree with the conclusion of Judge Carpenter upon this point, in *United States* v. *American Bell Telephone Co.*, 65 Fed. Rep. 86, 87. On appeal and in the Supreme Court, this finding was not overruled as erroneous, but only as unauthorized on a bill by the Government for the cancellation of a patent.

We have next to consider the questions arising on the work of Edison. Berliner's amendment of Aug. 8, 1877, must bear the date of filing. The date of the application for the patent in suit was not earlier than Aug. 8, 1877. On this view, Edison's application of July 20, 1877, for patent No. 474,231, is so clearly an anticipation of all that is claimed for Berliner by the complainant that we need not dwell upon it. Professor Cross says of the apparatus described in this application:

"I have no doubt, therefore, that the apparatus . . . . . was in fact, what it has universally been admitted to be, a microphone."

See also 126 U. S., p. 278. Professor Cross says, also:

"But although the apparatus . . . was a microphone in fact, my belief is, that Mr. Edison at the date of his application . . . and indeed long subsequently to this, believed that the apparatus operated by variations of the mass resistance of the material employed in the points."

But this, of course, is entirely immaterial. Here is the place for the proper application of the rule: "An inventor is not called upon to state and explain the principles of nature involved in the operation of his invention." Robinson on Patents, Vol. 1, Sect. 82; p. 124, Note 3.

Disregard all Edison's explanations or notions as to the scientific reasons for the success of his invention,— its success still remains. Edison's application describes and claims the invention; and does not, like Berliner's application, contain evidence that the applicant had not made and did not intend to claim it. Edison's application of July 20, 1877, throws upon the complainant the burden of proving that Berliner had made the invention of the patent in suit before July 20, 1877. This burden cannot be sustained.

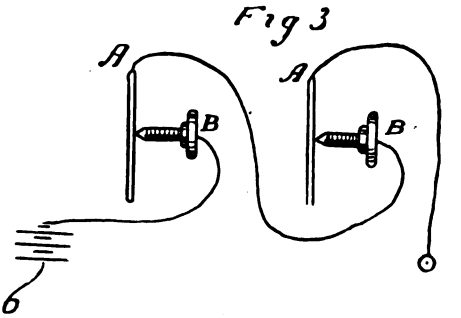
But, if we assume that Berliner did make an invention, and that his caveat of April 14, 1877, counts as a full reduction to practice, the complainant has still to meet the defence of the priority of Edison.

It is impossible in this opinion to consider all the contentions that arise on Edison's work, or all the relevant experiments, patents and apparatus. It is proven, however, that before the event in the telegraph office that suggested to Berliner the possibility of employing in telephony variable pressure or variable contact of solid electrodes. Edison had been engaged for a long time in experiments to find means to mould a battery current into undulations similar in form to sound-waves; that he always used a continuable contact of solid electrodes, Edison has been ous current and the vibrations of a diaphragm to control the approach and recession of conducting surfaces in constant contact. With various devices he had succeeded in getting some degree of articulation. As early as 1876 he had experimented with a Reis transmitter, and obtained results which he describes as follows:

"Q. Did you succeed in transmitting any words with it at that time?

"Ans. I cannot say; we generally knew what was coming, and, knowing what was coming, even a Reis transmitter pure and simple transmits and reproduces sounds which sound almost like that which is being transmitted; but when it was attempted to transmit something which the receiver did not know, it was very seldom that any word was recognized."

Fig 3



BERLINER DIAGRAM.

He rejected that as useless. By Jan. 20, 1877, he had thought of applying to the telephone the fact, discovered by him in 1873 that carbon placed in an electric circuit and subjected to varying pressure gave rise to remarkable variations of current. At this date he made an experiment which he says "was the first attempt to apply the property of carbon, of varying its resistance by pressure, which I discovered in 1873." This experiment was illustrated and explained by the following sketch and inscription:

"Three platina points don't seem to work any better than one point; get it very good on a Western Union relay through my teeth, but I think that I could get it better if I had an adjustment to it, for Charley can't hold it steady enough."

Edison testified:

"It consisted of a diaphragm and three platina points immersed in a dish containing loose carbon. The talking, though very poor in quality, was of a sufficient volume that it could be heard through the teeth when an ordinary Morse relay, the magnet of which was included in a circuit, was held against the teeth."

This preceded what counsel say was Berliner's date of conception, late in January, 1877.

It is clear, however, that Berliner's thought in the telegraph office was not a complete conception from which invention can date, but, as counsel say, "only an imagination of a possibility based upon analogy." He had merely found a line of investigation,— something worth looking into,— and con ception was incomplete until experiment led to discovery. The conception could date only from such discovery. *Clark Thread Co. v. Willimantic Linen Co.*, 140 U. S. 481, 489; Robinson on Patents, sec. 381. Before this, even Edison had made and recorded an experiment embodying the idea from which was developed the successful commercial telephone,— the use of a carbon electrode; and also, constant contact and variable pressure upon a solid.

The evidence of complainant's experts proves the importance of this experiment. In order to show that the defendant's carbon powder transmitter infringes, Professor Cross testifies that variations of current produced by varying pressure on a single contact and on a mass of powder were recognized by Du Moncel and Sir William Thomson as different examples of the same principle; and that

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"the mass of powder merely furnishes a large number of microphonic contacts." If Berliner is to be given a date of conception, "late in January, 1877," Edison surely, upon the same line of reasoning must be given an earlier date. His conception was embodied in an experiment; and, following this, it appears that, during January, February and March Edison and his assistants were busily engaged in taking advantage of the properties of carbon. This experiment, crude as it was, preceded Berliner's experiments to find whether pressure between a diaphragm and a metallic electrode would deflect a galvanometer. The importance of this experiment is that, if we adopt the complainant's view as to what constitutes a complete conception, we are obliged to give priority to Edison on this experiment alone, in the light of Professor Cross's testimony as to a mass of powder. By February 9, 1877, Edison had succeeded in transmitting speech "commercially," as he says, by apparatus which we have already illustrated, and upon which was based his application of April 27, 1877, for patent No. 474,230. The complainant's brief says that "The question whether Edison or Berliner first made a variable-resistance transmitter with solid electrodes, in which the external resistance may be varied, as Bell's patent says, has never been presented to a court until now." That Edison did produce speech with solid electrodes before Berliner is clearly proven; and the invention described in his patent No. 474,230, applied for April 27, 1877, has as its true date Feb. 9, 1877. This was before the earliest date given by Berliner in his statement in interference, March 4, 1877, when, as he said, "a person heard sounds, but could not generally make out the words that I spoke," and concerning which the person testified that he heard no words.

But upon no reasonable view of the testimony of Berliner himself can we give to him a date for the transmission of any words earlier than April 11 or 12, 1877 — the second date given in the statement in interference. If Berliner made an invention his date is not earlier than April 11, 1877. Before this date and by April 3 or 4 Edison had successfully transmitted speech, with other apparatus already illustrated, consisting of a diaphragm and "five vertical springs, each provided with a sleeve carrying a cylinder or button of hard-pressed plumbago fastened to a bar of insulating material. All the plumbago buttons were in contact, and the one at the end rested against the diaphragm. The circuit was complete from the first spring through all the carbons to the last spring." The instrument transmitted ordinary speech perfectly.

The complainant's counsel admit that the apparatus of April 1, 1877, is a transmitter involving the conception that the extremely minute vibrations produced by the human voice could produce sufficient pressure of one electrode upon another to change the current, since they contend that it operates by compressing the mass of the second electrode.

Preceding Berliner's caveat and his earliest date are at least three operative constant-contact transmitters employing a battery current, using the sound-waves as the motive force, and producing electrical undulations of the kind described in Berliner's patent; two of them having solid electrodes, and all of them practising the variable-resistance method of Bell, and all causing the current to vary proportionally to the pressure exerted at the diaphragm, and also proportionally to the pressure exerted by one electrode upon another; strengthening and weakening the electrical contact according to the movements of a diaphragm, increasing it as pressure increases, decreasing it as pressure decreases; and all embodying what is said to have been Berliner's radically novel conception, i. e., that sound-waves could produce sufficient pressure between contact electrodes to produce an undulatory current.

Many difficulties in this case arise from the complainant's attempt to show that Berliner's patent embodies a conception that was a radical novelty, and a mode of operation that was novel and generic; and to frame a generalization broad enough to include the defendant's devices (by disregarding differences in structure that are so material and important as to render any comparison in respect to practical efficiency or commercial utility out of the question), and that also will escape anticipation by the devices of Edison. If Berliner's invention was in fact merely an invention of apparatus for practising Bell's method, and is to be considered merely as an improvement upon the apparatus of Bell and Edison, there is clearly no infringement.

The defendants' "single contact transmitter" is substantially the well-known Blake transmitter, in which the contacts are of platinum and hard carbon, each supported on springs. This is described in Letters Patent to Blake, No. 250,128, dated November 29, 1881. The contacts are spring supported, so that they move with the diaphragm. The electrode of hard carbon shown in solid black in the drawing will demand particular attention. The second, or wall form, also employs carbon, powdered and enclosed in a cell, which cell is carried by a leaf spring. The cell is almost, but not quite, filled with granulated carbon, leaving room for motion and expansion of the particles of carbon. Two conducting plates or carbon plates form the front and rear walls of the cell. The movements of the diaphragm are communicated to the front wall of the cell, which presses more or less against the adjacent carbon particles, and likewise presses the numerous carbon particles within the cell into more or less intimate contact. This is said by complainant's experts to be a "multiple contact" transmitter.

The use of carbon in a transmitter is beyond controversy the invention of Edison. Edison was the first to make apparatus in which carbon was used as one of the electrodes, and Berliner, in the course of proceedings in the Patent Office, disclaimed carbon as an electrode. Professor Cross testifies that "No metal contacts of which I know could compete with carbon for practical commercial use," and that "All commercial transmitters, as far as I know, have employed carbon as the material of at least one of the electrodes." The carbon transmitter displaced Bell's magneto transmitter; and, under several forms of construction, remains the only commercial instrument. A transmitter with metal electrodes was never in commercial use, the magneto instrument being a better instrument for the practical transmission of speech than a Berliner transmitter with metallic electrodes. The advance in the art was due to the carbon electrode of Edison. Edison's structure, then, is distinct from the structure of Reis or Berliner and was patentable as apparatus and was an invention of very great importance. The complainant is attempting to subordinate a great invention. It is contended, however, that Berliner's invention was generic, and that it both precedes and includes the carbon transmitter. To sustain this contention is essential to the complainant's case, for otherwise the disclaimer of carbon is fatal. Berliner's transmitter and the defendants' transmitters are classified by the complainant's experts under the name "microphone," a name which, so far as applied to telephonic apparatus in commercial use, signifies that one of the electrodes is of carbon. The term was applied by Hughes in 1878 to designate apparatus invented by him, having carbon contacts, and designed to render very feeble or inaudible sounds with such intensity that they would become audible. This apparatus rendered audible the tramp of a fly. Professor Brackett says: "In some loose sense, the term 'microphone' has come to be applied to any kind of a loose contact variable-pressure transmitter when employed for telephonic purposes. It is quite clear that such use of the term is not descriptively accurate." He refers also to confusion in discussions relating to telephony likely to arise from the use of this term.

As we have to consider whether or not apparatus with an electrode of carbon is similar in substantial respects and in mode of operation to one with electrodes of metal, and embodies the same invention, the constant use of the term "microphone" by the complainant as descriptive of Berliner's apparatus is somewhat confusing, since it involves a begging of the very question that we have before us; and assumes that Berliner's apparatus is substantially similar to that of Edison and of Hughes. It is apparent, however, that Berliner did not anticipate the remarkable discoveries which Hughes disclosed to the world in 1878, and that these discoveries of microphonic facts should not be read into the patent of Berliner. These discoveries were not due to a "conception" but to investigation by intelligent experiment. No preconception could have embraced what Hughes discovered experimentally. Moreover, the apparatus of Hughes did not include a vibrating diaphragm. Nor should we be misled by the complainant's statement that the instrument described

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and claimed in the patent "is the only instrument capable of successful use in the transmission of articulate speech by electricity over such distances and in such situations as those for which the telephone is most practically useful and has hitherto been chiefly used." This is true of transmitters with an electrode of carbon, but not of Berliner's instrument. It is true of the carbon "microphone transmitter," but not of the metallic "microphone." It does not follow, because there may be resemblances between the instruments of Berliner, Hughes and Edison, upon which, in the light of subsequent knowledge and disregarding questions of practical utility and substantial differences in structure as well as the history of the development of practically efficient apparatus all as well as the old Reis apparatus and the Morse key, may be classified ex post facto as "microphones," or because there may be scientific resemblances between them, that the instruments are to be regarded as substantially resembling each other in the practical sense of the patent law, which is governed by considerations of utility rather than by the classifications of science.

What, then, was Berliner's invention according to the complainant? "Berliner's inventions do not reside in the structure involved." This is one of the reiterated propositions of the complainant's brief and argument. It is said that Berliner, "using substantially the old Reis structure, produced a new mode of operation." It is this "mode of operation" which the complainant seeks to monopolize. Identity in respect to mode of operation is proposed as the test of infringement. The complainant's use of the term "mode of operation" requires most careful scrutiny. Counsel say that Berliner's invention may be phrased in many ways; that it may be called an instrument "characterized by its mode of operation," an art, or process, or method; and that these different expressions are essentially the same. The case of the complainant rests upon the proposition that Berliner invented a "mode of operation," or process, or art. It is necessary, however, to draw a careful distinction between the "mode of operation" or modus operandi of an instrument, and a process or mode of operating upon an electric current, and a way of operating a Reis machine in order to preserve constant contact of electrodes. What is Berliner's "mode of operation," art or process or method? The patent covers no new process to be practiced upon electric current. The process performed upon the current is Bell's and is disclaimed. Neither the caveat, application nor patent refers to any novelty in the treatment of the current. The patent covers no new method of varying resistance, disclaiming varying resistance by sound waves. We have seen the fallacy of contrasting Berliner's "mode of operation" with that of Reis, since by this means the Berliner patent is made to cover again a portion of Bell's field of invention. Berliner's mode of operation must be contrasted with that of Bell's liquid transmitter and of Edison's apparatus. I believe, however, that this fallacy is essential to the complainant's contention that Berliner invented more than a mere variation of apparatus, operating according to the general method invented by Bell and applied by Bell and Edison.

According to the complainant's evidence, when the electrodes of Berliner's instrument transmit speech there are two joint effects produced by the vibration of the diaphragm: 1. The varying pressure of the electrodes, one upon another. 2. The varying discontinuity of the joint; in other words, the weakening and strengthening of contact. Each of these effects is in turn abstracted and selected by the complainant as the cause or explanation of the variations of the current, and erroneously termed a process, art or method, and we find either two explanations or two modes of expressing the same thing. 1. The mode of operation by variable pressure. 2. The mode of operation by varying transition resistance, to wit, the resistance due to the discontinuity of a loose joint.

We will first consider the "mode of operation by variable pressure." The argument follows the language of the claims and specification. Counsel attribute to Berliner the following conception: "I have a solution. I am going to vary the battery current by varying the resistance of the circuit — how? By varying the pressure between the electrodes by the operation of sound vibrations." In other words, he says: "I propose, as a means of solving this problem that many men and many minds have been engaged in, the following solution. It is a simple one. It is a precise one. I will vary the pressure as such between the electrodes which form a part of the circuit. Your honor will, I think, observe the precise and yet the satisfying character of that solution. It seems to me that it is neither too broad nor too narrow." The complainant's brief says:

"Berliner's idea of using the extremely minute vibrations produced by the human voice to vary the pressure between contact electrodes, so as to produce an undulatory current, was radically and absolutely new."

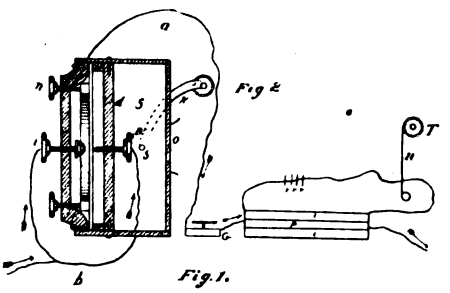

Fig. 1.

BERLINER DIAGRAM.

Professor Cross states that the operation of the transmitter depends in part upon these facts: First, variation of contact pressure at the electrodes produces variation of electrical resistance; second, that under the slight changes of pressure due to the voice the variations of resistance correspond to and are approximately proportional to the variations of pressure, and are great enough to yield practical results. The first fact, he states, was known but not utilized. The second, he says, was wholly unknown before Berliner. Counsel also describe Berliner's invention in the following language as "the discovery . . of the availability of pressure, as such, between electrodes, when varied by sound-waves, to vary the electric current in the required way." All this is too abstract, indefinite and vague. It disregards essential conditions and does not escape anticipation by Edison. If this is a full expression of Berliner's conception or discovery, then it is clearly proven that it was an erroneous and inadequate conception. Unless by the words, "varying pressure" is meant varying contact, all this is proven to be erroneous by the complainant's own evidence. A turn of a screw disproves the variable-pressure "mode of operation." It is not true that when electrodes in contact are brought together with greater pressure the resistance proportionally decreases; and conversely, when the pressure is diminished the resistance proportionally increases. If the screw is tightened so that the electrodes are clamped closely together there will still occur changes of pressure "between" electrodes proportional to the pressure upon the diaphragm, but the current will not be affected as desired. Here we have the best example of pressure "as such," but the current does not change. It is only when the electrodes are placed in loose contact so that changes of contact occur, and so that the contact is loosened and tightened, that changes of pressure are accompanied by changes of current. Eliminate these changes of contact and the cause of the variation of the current disappears. The "law of variable-pressure" is unsound, practically, and logically is misleading. It gives a nominal pre-eminence to that condition which is present both when the instrument is operative and when it is not. It serves to divert attention from the essential condition — variation of contact — and from the general resemblance of Bell's, Edison's and Berliner's modes of operation. Counsel mean by "variable pressure" variable contact. Berliner's variable pressure is a species of variable contact, and variable contact produced by sound-waves is the invention of Bell, and was used by Edison before Berliner.

Professor Brackett says:

"With the general statements of Professor Cross as to variations of pressure causing variations of resistance, I have no hesitation in agreeing if the in-

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termediate results be kept in mind, or if need be carefully stated, otherwise not."

He says also:

"I do not conceive that any special function is to be attributed to pressure merely as such, except in so far as it operates to produce a change in the amount of area in contact, or in the proximity of molecular areas which the electric current is to pass."

Professor Cross testifies:

"If the instrument is described as working by variation of pressure, that itself is a description that the contact is constant. The instrument could not work by variation of pressure unless there was constant contact."

But the words "variation of pressure" must mean not only constant contact, but varying contact as well. The instrument cannot work unless the contact is both constant and variable. By its "mode of operation by variable pressure" the complainant seeks to cover all transmitters operating upon a battery current by constant but variable contact of solid electrodes, "solid" being the only limitation it contends for as implied in the word "pressure." Is the complainant entitled to hold these defendants as infringers because their transmitters operate by varying pressure or varying contact of solid electrodes, or because Berliner first discovered that the minute vibrations of a diaphragm could produce sufficient changes in the contact of solid electrodes to transmit speech, or because he was the first to invent apparatus embodying the conception that sufficient pressure could be produced between electrodes to vary the current in the required way, or in which the pressure was intentionally weakened in order to cut down the current? Edison's apparatus of February 9, 1877, and April 1, 1877, anticipates all this, and shows that Edison before Berliner had discovered "that a force so feeble as that of a sound wave" could so vary the pressure between electrodes in constant contact as to produce the electrical undulations required for the transmission of speech. If the variable-pressure operation can be saved from anticipation by Bell through a distinction between a solid and a liquid electrode it cannot thus be saved from anticipation by Edison. The variable-pressure mode of operation limited to solid electrodes is anticipated by Edison, and the claims limited to solid electrodes are also anticipated.

So long as the complainant's counsel persist in pointing out as Berliner's novelty a single aspect of what occurs in the operation of his transmitter, and which occurs in all constant-contact transmitters, to wit, "variable pressure between electrodes" and insist that this is the ground for comparison in determining whether other devices infringe; so long as counsel insist that they need give no further description of the necessary apparatus than "electrodes in constant contact" or "solid electrodes in constant contact," or such vague description of apparatus as may be implied in emphasizing the words "pressure as such,"— so long must they submit to anticipation and to the destruction of their argument by each device that comes within the natural meaning of the broad, general terms whereby they seek to include the defendant's transmitters as infringements. The complainant cannot identify the defendants' transmitters with the defendants through so broad a generalization as "variable pressure between electrodes" or "variable pressure between solid electrodes," for, in making these generalizations so broad as to encompass the defendants, they at the same time so broaden the field of anticipation that they include prior devices of Edison.

Edison's application of April 27, which goes back to February 9, 1877, showed a diaphragm of sheet metal, in front of which was a plate or disk of suitable material having a conducting surface. He says, "I found that a disk of hard rubber coated with plumbago answers well, but a disk or some conducting metal or substance may be employed." He describes the adjustment and operation. There are two alternative adjustments, by one of which the circuit wires are contacted at opposite sides of the disk, when the apparatus is not within the terms of Berliner's patent. Another adjustment shown, however, is one wire connected to a disk and the other to a diaphragm. This is the arrangement shown in the drawing previously shown in this opinion, and dated February 9, 1877. "The disk or plate is accurately adjusted to the proper proximity to the surface of the diaphragm so that in a state of rest there will be little or no current passing from the battery upon the line; but the vibrations that are received by the diaphragm from the voice cause electric energy on the line to increase and decrease according to the *intimacy of contact* between the vibrating diaphragm and the surface of the adjacent disk, for if the electric conductors are connected to the diaphragm and disk respectively the current that passes will be pulsated and raised by the intimacy of the contact of the surfaces or the variable resistance where the conductors are in contact with the surface of plumbago or other poor conductor of electricity." Here the resistance of the circuit is varied: by diminishing and increasing the surface of contact, by varying the path of the current outside of the area of contact, and also by varying the intimacy of contact of the electrodes. Edison testifies to this. There can be no doubt that the inertia and solidity of the second electrode assists in bringing the electrodes into more intimate contact, exactly as in Berliner's apparatus. This is anticipation as to variable pressure. Here, also, is an example of apparatus "in which the pressure is intentionally weakened in order to weaken the current," which Professor Cross says was unknown at the date of Berliner's caveat of April 14, 1877.

The patent statutes require the patentee himself to claim and define his invention so that the public may know its rights, and so that there shall not be imposed upon the courts the burden of constructing upon a hearing new claims from the interpretations that experts may place upon language of the most general and sweeping character. It is for this reason that I am of the opinion, as before stated, that the claims of this patent should be held invalid, upon the concessions of the complainant. The court should not be compelled to attempt such an impossible task as that of finding out what kind of a contact is implied in the use of the word "pressure," when all substances are capable of sustaining pressure, and when anything which can be an electrode can undergo a variable-pressure operation. Nor should the court be required to solve such problems as What kind of material is it upon which pressure "as such," can be developed? and whether the pressure upon an electrode of hard pressed plumbago is pressure "as such;" or, what is the distinction between pressure of electrodes upon each other and pressure "between" electrodes? We have here in the solid electrodes of Edison the kind of pressure called for by the Berliner patent, and the exact method of operation called for by the Berliner patent, to wit, "By making the plate vibrate, the pressure at the point of contact becomes weaker or stronger as often as vibrations occur, and the strength of the current is thereby varied accordingly;" and if the complainant's case is to stand upon abstractions which disregard essential features of the structure involved, it is very clear that the defendants have completely met the complainant's case. Claim 1 and claim 2, the *prima facie* case and the "variable pressure" arguments, are rendered invalid by the work of Edison as exhibited in his apparatus of February 9 and April 1, 1877.

To avoid anticipation by the devices of Edison, the complainant has been obliged to abandon, practically, its variable-pressure theory; and, it seems to me, has recognized its vagueness and insufficiency and the necessity for giving a more specific description of apparatus than solid electrodes in constant contact, by developing a second theory.

We have next to consider a second generalization — the "mode of operation by varying transition resistance." Upon this the complainant seeks to identify the defendants' transmitters with that of Berliner and to avoid anticipation by Edison, and also to avoid a concession that Berliner's invention was merely an invention of apparatus. The attention is now directed to the second of the joint effects following the movement of the diaphragm, to wit, the variation of discontinuity; the weakening and strengthening of the contact.

The language of the Government Bill is quoted with approval and is adopted by the complainant:

"The principle upon which such an apparatus operates is as follows: The discontinuity of conducting material at the point of contact between the electrodes creates a resistance to the flow of current, which resistance is increased by lightness or weakness of pressure between the electrodes, and decreased by closeness or force of such pressure. By increase of resistance in this manner the electric current flowing in the circuit is weakened, and by decrease of such resistance it is strengthened."

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Professor Cross on rebuttal states the theory of transition resistance in the following language:

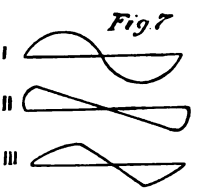
"When two electrodes are in contact, and a current passes from one to the other, there is a certain resistance to the passage of the current offered at the joint which is constituted by the surface of contact of the two electrodes. It is a resistance of a different character from that of the body of the electrodes themselves, and is independent in its magnitude of the resistance of the material of the electrodes. Its precise cause is not known; but it occurs only when the current passes across such a joint as I have referred to. This resistance is varied enormously by variations in pressure, and practically disappears when the pressure is other than slight or moderate. From the fact that this resistance manifests itself in the passage of the current from one electrode to the other, and that the phenomena relating to it are manifested only at the joining surface of the two electrodes when the current is in transit, as it were, from one to the other, it is very appropriately called 'transition resistance.'

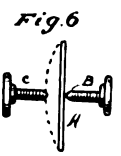
"Variation in transition resistance is the basis of the action of the microphone. It . . . is caused to vary by properly varying the pressure between the two electrodes in contact. That is the only mode of operating a telephone transmitter by varying transition resistance which has ever been utilized, or which, so far as has ever been shown, is experimentally practicable."

It is necessary in this case to be carefully upon our guard against confusion by verbal differences. When we wish to say that a contact changes so as to afford a greater or lesser facility to the passage of the current, we may use a different but equivalent expression and say that the resistance changes. This introduces a verbal novelty, but no real difference. The circuit is continuous when the contact is so close that, so far as the phenomena of the current are concerned, the joint behaves as if the electrodes were unbroken, and is discontinuous when less than the full amount of current passes.

Transition resistance "is always dependent upon the presence of a break or joint whereby physical continuity of the contact is interrupted to some extent," as is stated by Professor Cross. This, of course, is merely descriptive of apparatus. The extent to which this break is lessened or increased determines the action of the current. But this general language of Professor Cross's descriptive of transition resistance is applicable to the Edison apparatus of February 9, 1877. Edison's patent, applied for April 27, 1877, contains a very much better description of "transition resistance" than does the Berliner patent. We have already quoted an extract from Edison's patent that shows a resistance to the current which results from an initial adjustment of electrodes "so that in a state of rest there will be little or no current passing." Here is "loose contact" and transition resistance between solid electrodes as defined by Professor Cross. As pressure increases the initial transition resistance existing in the apparatus in a state of rest and due to discontinuity of the joint is decreased. Edison has shown a much clearer conception of the resistance due to a break or joint or loose contact than Berliner discloses in those parts of his application which were not affected by any alleged mistake of his solicitor. Berliner gives no directions that the initial current shall be less than is able to pass with full contact; the only transition resistance that he contemplates, apparently, is that put in by the vibration of the diaphragm. His transition resistance consists in weakenings of the initial contact. This was the conception shown in that part of the application which relates to weakening the current. His caveat, claim 4, described the operation of the transmitter, "vibrating the plate and diminishing the amount of electricity passing as many times and as much as the vibrations will loosen the pressure of contact." The application discloses no conception of an initial resistance that can be diminished. Counsel have quoted scientific authority for the statement "that the gist of the invention (of the microphone) seems to lie in obtaining and perfecting that which electricians have hitherto most scrupulously avoided, namely, loose contact." This of course relates to apparatus.

In fact the evidence of experts upon the subject of transition resistance and as to the absolute necessity for a loose joint properly adjusted comes very nearly to the point of proving the insufficiency of the specification of the patent in suit. But varying transition resistance is merely varying contact. The resistance is caused by the discontinuity of conducting material or by the joint, which must be loose. To change the resistance we must change its cause — change the discontinuity; to change the discontinuity is to change the continuity, that is, to change the contact. This follows from a mere interpretation of language. The experts for the defendants prove that in all transmitters the variation of current depends upon variation of contact. Professor Anthony says: "There is no other cause of variation of the contact resistance, except variation in the area of contact of variation in the proximity or what I have called the intimacy of contact, between the particles."





BERLINER DIAGRAM.

Professor Cross does not deny the evidence of the defendants' experts but says: "I believe that it (the change in resistance) does depend upon the proximity of the electrodes, and so upon the proximity of the particles of these. I know of no evidence to show that it depends upon the area of the electrodes in contact. I don't know anything about the number of particles of contact, and I don't believe that anyone does. Very likely variation in the transition resistance may depend upon this, it being, as I have said before, a plausible hypothesis, though an entirely unproved one." But for the purposes of this case we are obliged to hold that the defendants have shown by a preponderance of evidence that varying transition resistance does depend upon changes in area and intimacy of contact. Upon his whole evidence Professor Cross practically concedes it. Professor Cross was asked:

"*X-Q.* In the case of two solid bodies constituting a loose joint in an electric circuit, is it your opinion that varying pressure between them does not vary the area and intimacy of contact of the two electrodes?

"*Ans.* It is not my opinion. I believe that it does.

"*X-Q.* Is it your opinion that such variation in intimacy and area of contact of such electrodes does not cause variations of resistance?

"*Ans.* I believe that variation of intimacy of contact, by which I mean merely the change which takes place when the electrodes are subjected to pressure, whose character I do not pretend to determine, does produce a variation in resistance. Whether variation in area of contact produces a sensible change or not in an ordinary microphone, I cannot say. Of course, theoretically, any change in the area of contact would be expected to produce some change in the resistance, but whether this is present to any material extent in the ordinary action of the microphone I cannot say."

Professor Cross finally says: "The actual cause of the existence and of the law of variation of the transition resistance has never been certainly proved."

Complainant's counsel and experts attempt to distinguish the prior apparatus of Edison having solid electrodes, by saying that it was Edison's intention to vary the density of the plumbago by mass compression, and to vary the area of contact as distinguished from the intimacy of contact. But no sound legal distinction can be based upon an assumed or expressed intention of Edison. The distinction must be made as to actual apparatus, and its actual manner of changing the current. Robinson on Patents, Vol. 1, Section 82; *Eames v. Andrews*, 122 U. S. 40, 55.

When counsel, upon the supplemental brief, say that Berliner's method is different from that of *merely* changing the surface area of contact, and from that of *merely* changing the molecular condition of one part of the circuit, they assume without

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sufficient warrant that Edison's apparatus did in fact so operate. They are "guessing at what occurs between the electrodes" of Edison. Both sides agree that this should not be done. Edison, before Berliner, was applying to the telephone the fact that when carbon was pressed a remarkable variation of current followed. If he did say he had discovered that plumbago had the property of changing its resistance under pressure, it does not follow that he thought that all the changes took place in the interior of the second electrode. If he thought that the instrument operated in any part by changes in the conductivity of the material of the circuit he had also conceived of cutting down the current by weakening the pressure so that a small amount of current would pass on the initial adjustment, and a greater would pass as the pressure became greater, and the contact more intimate. But more than this, he had made the instrument and described the mode of operation of the Berliner patent.

His evidence is that he employed varying "intimacy of contact" to vary the current; and his patent, applied for April 27, 1877, says so. But the complainant's experts do not avoid anticipation by Edison by limiting Berliner to transition resistence; for Professor Cross says of Edison's apparatus of the application of April 27, 1877:

"If, however, the transmitter was purposely adjusted under very light pressure, so as to operate as a michrophone, which of course it can be used to do, with our present knowledge, though ineffectively the test circuit gave evidence of michrophonic action."

But Edison describes an adjustment under very light initial pressure both in his application and in his sketch of Feb. 9, 1877. Another distinction upon which the complainant seeks to avoid anticipation by Edison is the evidence of Professor Wright that there is no sensible microphonic action in the apparatus of the patent No. 474,230, of April 27, 1877; and of Professor Cross, that with that instrument so adjusted "as best to secure the cutting in and out of resistance, ... no material microphonic action need be present; and, so far as I can ascertain from careful experiment, no microphonic action is sensibly present in its operation." It is here conceded that speech can be produced by solid electrodes without microphonic action. But absence of "microphonic effect" would not save a defendant from infringing the patent in suit, and does not prevent anticipation.

The patent is not limited to electric undulations that manifest microphonic action. It affords no basis for any discrimination in respect to quality of electrical undulations.

Neither the specifications nor the course of evidence in this case will permit the patent to rest upon differences that an expert ear may detect between undulations similar in form to sound-waves. Upon Berliner's own evidence, it is apparent that he had not reached the point of discriminating between the quality or efficiency of tones produced. There is no evidence that such microphonic effect as may be produced by Berliner's metallic electrodes is of the slightest practical importance upon a comparison of his apparatus with the prior apparatus of Edison, or that it made any advance over the magneto instrument. Berliner was not the discoverer of any improved effects demonstrated to his ear. But this distinction is of little practical importance for the further reason that "transition resistance," localized at the contact of electrodes, and microphonic action, were in the Bell mercury — plumbago transmitter.

Professor Cross says:

"If we immerse the plumbago more deeply, and exclude the immersion varying operation in this way, it is possible to transmit speech microphonically. That this is the case is shown not merely on theoretical grounds, but also by the peculiar harsh, scratchy character which characterizes a poor microphone . . . . with a wire just touching the mercury surface, and particularly if the formation of a meniscus can be avoided, it is possible to transmit speech apparently by microphonic action. In this case the peculiar characteristic sounds of a poor microphone are evident." He says, "When plumbago is used with mercury, it is difficult to exclude the presence of microphonic action to a certain extent."

Professor Dunbar, defendant's expert, made experiments to show that the operativeness of the Bell mercury transmitter is not altogether dependent upon the amount of immersion of the wire, using as one electrode a conducting wire with the surface insulated except at the extreme point. He says:

"With the platinum wire insulated on its sides and presenting a conducting surface only at its submerged end, and using mercury for the liquid, speech was obtained of good articulation, although fainter than when the sides were left uninsulated."

I am of the opinion that the defendants have proven that Edison is a prior inventor of the invention of the Berliner patent, even if we assume that it bears date June 4, 1877, and rests upon the caveat of April 14, 1877; and that Edison anticipated Berliner in the construction of apparatus having constant contact, variable pressure, and varying transition resistance. But it is not at all necessary for the defendants to prove that Edison was a prior inventor. The case might well be disposed of on one short ground, to wit, the variable resistance of Edison's apparatus is an invention distinct from the variable-resistance of Berliner's apparatus, and the method of operating upon each kind of resistance is Bell's. The carbon transmitter used by the defendants is the invention of Edison, and an invention substantially distinct from that disclosed in the Berliner patent; and whether it preceded or followed Berliner's caveat or application is immaterial. The thought that the Reis apparatus might be made to perform Bell's process upon a current cannot be regarded either as a conception that was radically novel, or as an intellectual solution of the practical problem of speech transmission. According to the view of the Supreme Court, Bell taught Van der Weyde what to do in order to use a Reis instrument so as to make it transmit speech. 126 U. S. 545, 544, 542. Edison, in 1876, had this thought, but its practical inadequacy is shown by the fact that so skilled an experimenter found the Reis transmitter useless without alteration; though he was able to change the current and produce audible effects. If it has since been found that the Reis transmitter can transmit speech; if it has been discovered that such minute changes of contact as can be produced between metallic electrodes are sufficient, it is this discovery, and not the thought of making and experimenting with apparatus that is substantially the Reis apparatus, which is the substance of the invention of the Berliner patent.

The discovery of what can be accomplished with metallic electrodes is not the discovery that is utilized in the carbon speech transmitter. Edison solved the problem in another way. He says:

"I sought to devise a transmitter, or rather, an addition to the Reis telephone, which allowed me to talk low or to talk strongly, and have the same reproduced low or strongly. I felt certain that when this was accomplished speech could be transmitted and reproduced."

He found that carbon placed between the electrodes of the Reis transmitter makes it a very good transmitter. He thus dispensed with the necessity of employing such changes of contact as are used in the Berliner transmitter, and solved the problem by constructing new apparatus. Professor Brackett says:

"The introduction of carbon as one of the electrodes at once resulted in a variable-resistance transmitter which was of practical use, as is universally conceded. The reason for this result, I believe, may be found in those peculiar properties of carbon which distinguish it from other solid conducting bodies, some of which I may specify. While it is classed among the conductors, it offers greater resistence, other things being equal, than do most of the solid metals. It presents a surface which unlike the surfaces of metals, is characterized by what may be perhaps termed 'fluffiness,' by which I mean its surface presents great numbers of irregularities, so that portions of it rise above other portions, and so present innumerable prominences or elevations fitting it to readily yield to pressure applied by other solids brought in contact with it, so as to produce very great variations in what I will call the molecular area, as contradistinguished from visible area. I mean, of course, that greater variations of the numbers of molecules confronting an opposing body, which is acting upon it by variable pressure, will be produced than would be produced under like circumstances in the case of a solid metal. This property alone would mark it as especially suitable for use in a loose-contact variable-pressure transmitter. Also, the oxidation products which are liable to be formed on the passage of a current, are a gaseous character, and so will be at once removed from the surface by

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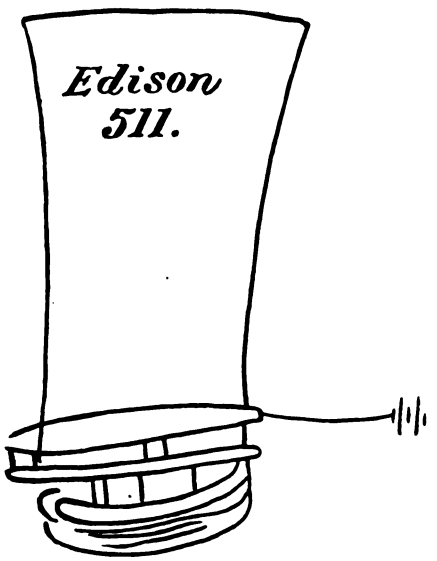
diffusion, thereby leaving the surface practically unchanged in character; and again, when a current of electricity passes a carbon conductor, the heat thereby produced diminishes its resistance, and so allows the current to pass more freely. These three circumstances severally and jointly tend to produce a very considerable variation of resistance to the passage of a current, and thereby make the range of action, when small differences of pressure are applied, correspondingly considerable. Possibly and likely other properties of carbon which are not well understood may conspire to produce the result in question."



SPEAKING TELEGRAPH, JANUARY 20, 1877.

EDISON TRANSMITTER.

Professor Wright says:

"I have spoken of the large range of carbon. By this I mean that the pressure upon the joints of the electrode may be varied within comparatively wide limits before the vibrations in the current which are produced by the pressure cease to be such as can be practically employed, in the transmission of speech. This has an important practical advantage in the fact that the adjustment of the instrument is much more easily obtained by simple mechanical arrangements than in the case of metal where this range is small.

Edison discovered that carbon alone possessed the necessary range of contact to make a practical variable-pressure transmitter. The peculiar characteristics of carbon have given carbon transmitters the entire commercial field. Edison found that the practical way of turning the Reis transmitter into a speech transmitter was not to invent a mode of operation new over Bell, but to invent the carbon electrode.

It is proved that the Bell magneto instrument is superior for practical purposes to Berliner's instruments with metallic electrodes, while the carbon transmitters are superior to the magneto instrument. The carbon transmitter could never have been found in the Berliner patent. It is not the fact that the commercial telephone was developed from a new conception disclosed to the world by the Berliner patent or caveat. Berliner's experiments and Berliner's patent conferred no knowledge as to carbon. It is not disputed that Edison's invention was developed by him independently; and it is also contended by the complainant that his invention was perfected without the conception which is said to constitute Berliner's novelty. Upon the complainant's contention, the conception of transition resistance was one that was not essential to the development of a microphone transmitter. An immense amount of painstaking and highly ingenious experiment preceded Edison's successful result. The discovery of the availability of carbon was unquestionably invention; and it resulted in the "first practical success in the art." The difference between carbon and metal is a difference that has made the advance in the art.

The actual uselessness of the Berliner transmitter, the limited character of the disclosures in the Berliner specification and of the experiments and discoveries of Berliner, and the independence of Edison's invention, prevent us from treating this patent as a document which disclosed to the world an idea from which resulted a practical success. It is conceded that the Edison transmitter as apparatus is a very important invention. All the encomiums bestowed upon Berliner are based upon what has been accomplished by Edison's carbon transmitters. It is contrary to common sense, and contrary to the spirit of the patent laws, that the work of Edison should, by virtue of after-acquired knowledge of skilled experts and by virtue of their use of the discoveries of Edison himself, be subordinated to the claims of Berliner's patent.

I think that the defendants have established the proposition stated under the fourth defense: "If Berliner had never experimented in telephony, that art in June, 1877, would have been precisely the same; and that art today would be precisely where it is," as the result of the work of Edison. If the Berliner patent, or the Berliner apparatus, is to be treated as a practical embodiment or disclosure of a discovery, what is this discovery? That a variation of pressure like that which was adequate in the case of liquid transmitters to produce the variation of resistance was also adequate to produce a variation of resistance between solid metallic electrodes; or that such minute changes of pressure or contact, as could be produced with metallic electrodes would cause Bell's process to be practised upon the current. The patent, on its face, shows that Berliner claimed no novelty in the process performed upon the current, nor in the mode of operating upon the resistance of the circuit; that he disclaimed what counsel now claim for him — a new mode of operation. The discoveries of Berliner were so limited that upon summing up counsel for the complainant say:

"We have, then, as the result of the proofs on the part of Mr. Berliner, that he not only had an inventive conception, but that he constructed a series of instruments to embody it, and that those instruments did transmit the quality of sound, and when tested at the present time demonstrate their own effectiveness to transmit speech."

The conception, however, when reduced to definite form, resulted in apparatus that was substantially the Reis apparatus. The fact that Berliner himself constructed this apparatus is of no consequence in determining the character or scope of the conception. This amounted to no more than a thought that old apparatus might be operated by Bell's method. The discovery was that the quality of sound could be transmitted, and that he "now and then thought he could make out the words of familiar sentences, but it was exceedingly faint." According to Berliner's own testimony, this was the limit of his discovery. These are the only microphonic facts that he discovered. The microphone was not the result of a conception, but of a discovery of facts. Berliner did not discover, nor did he state the principle of the microphone; for, according to the evidence of the complainant, this principle is unknown, and according to the evidence of the defendants it is Bell's principle of variable contact produced by the pressure of sound-waves. The discovery that any new or improved effect upon the current would result was not made by Berliner. As a discoverer of microphonic facts, he made no practical advance upon Reis (126 U. S. 540, 541); and added little or nothing to what Edison had learned as to the capacity of the Reis apparatus. As a "conceiver," he conceived only what Edison had conceived and tried with similar results before him. Berliner did not conceive that solid electrodes would produce an effect such as was afterwards distinguished as a microphonic effect, and he did not discover any difference from the magneto transmitter in the effects on the current.

Edison, by independent investigation, made discoveries of very great importance as to the effects produced with different materials in different adjustments, and made over the Reis transmitter into a

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practical speech transmitter. The subsequent or previous discovery that the old Reis transmitter could be made to perform the operation may be of scientific interest, but upon no principle of common sense can it be made to control and anticipate the solution of the practical problem by Edison's different experimental method.

The utmost that Berliner can be entitled to is apparatus substantially like that disclosed in his patent, when used for the transmission of speech. So hopeless is the complainant's case, if Berliner's invention is to be considered merely an invention of apparatus for practising Bell's method, that the complainant persistently ignores all comparisons of Edison's and Berliner's transmitters in respect to practical utility, and insists that the test of infringement is comparison as to a method or process involved in the apparatus. It is clearly shown by the defendants that the Berliner patent does not disclose, and that Berliner did not invent, a new art or process.

Upon what is the Berliner process or art practised? Not upon the current; not upon the resistance of the circuit; for this is all disclaimed and is Bell's. Leaving out manufactures and compositions of matter, the patent law provides no middle ground between patents for an art and for a machine. Berliner's invention of a "new mode of operation" seems to be neither an art nor a machine, but an abstraction which may be described, in the language of Chief Justice Fuller, as "a disembodied shape in an intermediate state of ambiguous existence." See *Westinghouse* v. *Boyden Power Brake Co.*, 170 U. S. 555, 556. Having first in the patent and in the *prima facie* case claimed broadly the method of Bell's patent when practised between opposing electrodes, and every form of constant-contact transmitter that it is possible to make, the complainant seeks to save its broad generalization by excepting from it various kinds of apparatus that come within its terms; but, after all these exceptions are made, the complainant's claims still have a scope to which they are not entitled. The generalization can be corrected only by the admission that the method of operation is Bell's method, and that it does not constitute a new method to construct a new kind of circuit or to make a new kind of variable resistance.

As a matter of fact, the complainant's case on rebuttal shows a substantial departure from the contention that Berliner did invent a new art, process or method, and actually rests upon the proposition that the Berliner patent is to be construed as claiming and covering all telephonic apparatus having transition resistance. The new distinction introduced by the expert evidence as to transition resistance is an implied limitation as to apparatus. First claiming broadly all electrodes; then, by arbitrary exception not found in the terms of the claims, limiting itself to solids to avoid Bell's liquid transmitter; it now limits the apparatus to electrodes having transition resistance in order to avoid Edison's solid electrodes. We should remember that the fundamental proposition of the complainant, upon which learned and astute counsel have deliberately based this very important case, is that Berliner's invention does not reside in the structure involved,—"not in mere parts of metal or other conducting material so placed in an electric circuit as to serve as electrodes, but in a mode of operation whereby the sound-waves, by varying the pressure between these electrodes, vary the contact or joint between them." Transition resistance, however, does reside in the structure involved; and it is perfectly manifest that, assuming the existence of apparatus having transition resistance, the method of varying that resistance is the same as for varying any other kind of resistance, to wit, the method of Bell's patent, claim 4,— gradually increasing it and diminishing it by sound-waves.

Counsel say that the words "electric speaking telephone transmitter operated by sound-waves" obviously bring in the mode of operation and the force which operates. This is an exposure of a fundamental fallacy in complainant's case, to wit, the claim that the making of a new kind of circuit or a new form of resistance makes a new method or art that includes a novel relation of sound-waves to this new kind of resistance. Bell's art covers resistance of any kind, and only the new thing upon which his method of claim 4 is to be practised is patentable after Bell. There is no shadow of invention in the use of the minute force of a sound-wave to effect changes in a circuit after Bell and Edison. There is no shadow of invention in using sound-waves upon an instrument for the transmission of sound, after Bell. Sound-waves as the motive force, and electrical undulations conforming thereto were factors in the problem given by Bell. Bell's patent covers sound-waves brought into a new relation with an electric current, and also into relation with the resistance of a circuit, whatever its kind.

The complainant could not stand for a moment upon the proposition that Berliner made any new discovery as to the force that a sound-wave can exert upon a circuit. The only scope for invention, after Bell, is in the apparatus employed to obey his law. The vibrations of a diaphragm under the sound-waves involve no novel elemental action not previously in Bell and Edison. The patent disclaims novelty in the process practised upon the current. The form of undulations, not their character, is all that is claimed. It was a known fact that the Reis apparatus could control the electrodes so as to strengthen and weaken the contact; that the vibrations of a diaphragm were of sufficient force to accomplish all that Berliner described in his application; that is, to weaken the initial contact of electrodes down to the breaking point. In the Reis musical transmitter, as well as in Bell's liquid transmitter, was shown all that Berliner needed to learn as to the power of sound-waves.

Some confusion has arisen from the fact that it is proven that the Reis apparatus, or Berliner's, is like a tool which, at the pleasure of the operator, may be made to perform the breaking operation of Reis or the variable-pressure operation of Berliner. The operator may turn the screws so that the contact will be broken, or so that it will be preserved, or he may drop his voice in order to preserve contact; but the patent covers no art or skill required to keep electrodes in constant contact, or if it does is not infringed in this respect. The "method" of claim 1, and which "characterizes" the instrument of claim 2, requires, as a condition precedent, electrodes in constant contact. Professor Cross says, "Constancy of contact will not transmit speech;" and that the variable-pressure operation is impossible when there is no contact. If there is an art or method of preserving the contact of electrodes which, in view of the experience of Edison and Berliner, and the evidence of experts as to experiments with metal electrodes, seems not improbable, it is not the method or art set forth in claim 1, and should not be confused with it. The method is "by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact." The patent sets forth, as the only means of securing constant contact, a screw. The "causing" is accomplished by placing the apparatus where there are sound-waves. This is a very different thing from Mr. Bell's "causing electrical undulations" as a method of transmitting sound, or of causing the resistance of a circuit to vary in accordance with sound-waves. Berliner's solicitor has not succeeded in paralleling Bell's claim 5. The production or selection of sound-waves is no part of a new art or process. When the exhibitor of the apparatus speaks, he is merely producing sound-waves, which is no part of the method of causing them to produce electrical undulations of similar form. If he drops his voice so that it will be a weak force, he is merely producing sound-waves appropriate to the particular form of apparatus. If he finds a weak voice coming through the air, that will answer. Dropping the voice to feeble tones is an equivalent to a turn of the screw which is set forth in the patent as the means of preserving the contact.

No new art or method can be practised in front of the diaphragm. Berliner's mode of operation cannot be brought in upon the sound-waves. It is all determined by the structure of the instrument. If the art is to be practised at the diaphragm, or if it is to be practised in putting a suitable amount of transition resistance into the circuit, the patent is certainly bad, since it leaves this art or method to be discovered by experiment. Professor Brackett truly says, "So far as the method of operation is concerned, there is no novelty over Bell." There is also no novelty in mode of operation over Edison, even assuming that there is a novelty in the kind of resistance operated upon. The fact is that the complainant's fundamental proposition that Berliner's invention resides in a new mode of operation is erroneous. Berliner's invention, assuming that he made one, does reside in and is limited by the structure involved; and amounts simply to a discovery of the capacity of a specific structure to obey Bell's law.

Berliner was not the first to introduce transition

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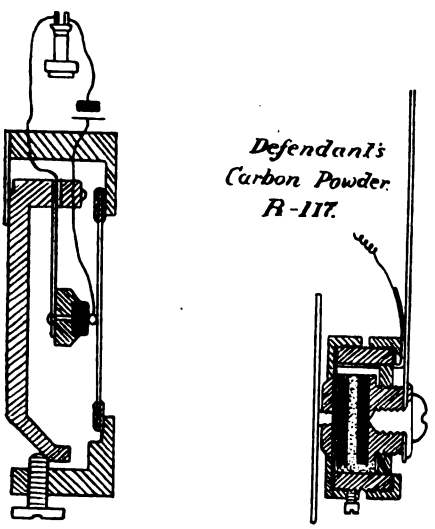
resistance into a circuit. The complainant concedes that Berliner was not the first to make the apparatus which it terms a microphone. The Reis apparatus is conceded to be a microphone, and to have such transition resistance that it is capable of transmitting speech. Reis's failure was due to the fact that, in operating his machine, he put in so much transition resistance that he interrupted his current. It is unjust to these defendants that this case should be tried upon the theory of transition resistance, or upon the German patent to Ludtge; but I am of the opinion that, even if Berliner's claims are to be interpreted in the light of expert evidence as covering all transmitters having transition resistance between electrodes, these claims are of excessive breadth, and go far beyond the scope of any conception or discovery of Berliner. If Berliner discovered that such transition resistance as existed ready to his hand in the Reis transmitter was capable of varying the current, this gave him no right to claim any and all apparatus having transition resistance. As he does not describe it, gives no specific directions as to the amount necessary, gives no evidence that he made any investigations in consequence of a conception of this character, his utmost claim to transition resistance is to such as was involved in the structure which he used, to wit, such transition resistance as is possessed by metal electrodes when properly adjusted. Professor Cross says of the granules of the powder form transmitter: "The carbon employed is of such a character as to possess a high transition resistance at the contact points." The complainant cannot monopolize a resistance "possessed" by carbon.



FORMS OF CARBON TRANSMITTER.

It follows that the Berliner patent, if it is valid at all and discloses an invention, is nevertheless so limited that it does not include the defendants' devices. Claim 1 for a method is invalid. Counsel justly say of this claim, "We have claimed as a method the operation of the apparatus exhibited; nothing more."

Counsel for defendants contend rightly, I think, that the so-called "method" is mere phraseology, and merely an indirect description of apparatus. They say, "Why could not Mr. Hunnings have said, 'I claim the method of producing undulations in a circuit by causing the sound-waves to vary the pressure upon the flexible wall of a cell containing carbon powder included within the circuit, and thereby increase and diminish the resistance of the circuit?'" If, after Bell, the Berliner method claim is good, every inventor of a new form of transmitter may base upon the peculiar features of his apparatus a new method claim for a process involved in the operation of his apparatus.

Berliner did not alter Bell's variable-resistance method by applying it to the Reis electrodes, which the Supreme Court said Bell had taught Van der Weyde how to use, and might himself have used instead of the apparatus which he adopted. 126 U. S. 540. *Westinghouse* v. *Boyden Power Brake Co.*, 170 U. S. 537, 554-557. Like the method of the patent, the mode of operation by variable pressure and the mode of operation by varying transition resistance are merely indirect and abstract descriptions of a part of what occurs in the operation of particular apparatus. We may test the identity of meaning conveyed by these various expressions by giving a Reis apparatus to three practical electricians; by telling the first to operate it according to Bell's method; the second, according to the variable-pressure method; and the third, according to the varying transition resistance method. If these persons are sufficiently intelligent to comprehend what is meant by these instructions, each will do exactly the same thing. If this cannot be done without further invention, then it seems that the Berliner patent is invalid for an insufficient specification.

It is furthermore important to observe that no method was claimed until 1880, after two years' public use. For this reason alone, claim 1 is invalid. The patent, therefore, must stand, if at all, upon claim 2. Taken literally, it is anticipated by the Bell mercury transmitter, and by Edison's devices of Feb. 9 and April 1. The patent confines itself to metal for the pin or second electrode, and carbon was disclaimed. Construed from the specification, the disclaimer of carbon and the experience of the patentee, as detailed in his testimony, it covers only its described electrodes and their known equivalents. Carbon was not a known equivalent. This claim cannot cover all solid electrodes, because, after Bell's invention, the problem was not to find a new method, but to discover a better material than Bell's mercury electrode. The claim cannot cover all solid material, for solidity of contacting surface is not in and of itself enough to make an apparatus practical or commercial.

In *Edison Electric Light Co.* v. *United States Electric Lighting Co.*, 52 Fed. Rep. 308, it was said:

"The degree of difference between carbons that lasted one hour and carbons that lasted hundreds of hours seems to have been precisely the difference between failure and success, and the combination which first achieved the result 'long desired, sometimes sought and never before attained,' is a patentable invention."

The decision of the Supreme Court in The Incandescent Lamp Patent, 159 U. S. 465, 476, is exactly in point. There it was said:

"Under these circumstances, to hold that one, who had discovered that a certain fibrous or textile material answered the required purpose, should obtain the right to exclude everybody from the whole domain of fibrous and textile materials, and thereby shut out any further efforts to discover a better specimen of that class than the patentee had employed, would be an unwarranted extension of his monopoly, and operate rather to discourage than to promote invention."

In that case the patent was held void. Fibrous or textile material was "too indefinite to be the subject of a valid monopoly."

In the present case, we have not even an equal limitation, for claim 2 does not mention solid material for the electrodes, but simply electrodes in constant contact — language broad enough to include various transmitters which are acknowledged not to be within the scope of Berliner's invention.

I am, therefore, of the opinion that even if the complainant were able to prove that Berliner had in fact made an invention; that his application upon its face disclosed this invention; that he was lawfully entitled to make the amendments; and that his previous patent of 1880 did not exhaust the power of the Commissioner to grant the patent in suit, and that he was not anticipated by Edison; that, even after all this, well-established rules of law would require us to hold that claim 1 of this patent is void, and that claim 2 is either void or so limited that it does not include the defendant's transmitters.

It has been impossible, in this opinion, to consider all the points of the very able arguments that have been presented, or all the important contentions that have arisen. The brief of the defendants has met the case of the complainant thoroughly and completely, and with very exceptional ability and commendable fairness has demonstrated, in my opinion, that the complainant's case rests upon a patent that

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should not have been granted, and which is void for error apparent upon the face of the records of the Patent Office; that, as a matter of fact, Berliner on June 4, 1877, the date of his application, had not made the discovery that speech could be transmitted with the apparatus of the patent in suit, and was at that time, and long after, like other unsuccessful experimenters, attempting to use a broken current. In addition to the fundamental defects in the complainant's title to the patent, it appears that the best argument that skilled experts and learned and ingenious counsel can base upon this patent is logically untenable and legally unsound.

The bills will be dismissed.

A BRIEF SKETCH OF L. W. STANTON.

Mr. L. W. Stanton was born in Barnesville, Ohio, in 1872. At the age of fourteen, while attending high school, he associated himself with Mr. C. M. Cole, a hardware dealer of that place, and established the Stanton & Cole Electric Company.

MR. L. W. STANTON.

In 1893, immediately after completing a course of electrical engineering, he accepted a position to assist in installing the first independent exchange in the State of Ohio, which was at Cambridge. From here he accepted a position to install and manage the exchange at Barnesville, Ohio, and later went to St. Louis, Missouri, for the purpose of gaining an all-round knowledge of telephone engineering. He secured a position with the Bell Telephone Company, which was then just installing its new common-battery exchange, and worked in nearly every department of construction until the exchange was completed. He then secured a position with the National Conduit & Cable Company while it was surveying for and constructing the conduit system for the Electric Light & Power Company, of St. Louis, Missouri, and later worked for the Standard Underground Cable Company while it was installing the cable for the Kinloch Telephone Company, and upon the arrival of the switchboard he secured a position with the Kellogg Switchboard & Supply Company. After the completion of the work in St. Louis, he was sent by the Kellogg Switchboard & Supply Company to install the switchboard of the Cuyahoga Telephone Company, of Cleveland, which is the largest switchboard in the country. After completing this work, he accepted the position which he now holds with the Federal Telephone Company, which company controls the United States Long-Distance and the Cuyahoga Telephone Company, as well as a number of others.

A GOVERNMENT EXCHANGE.

The advantages of a telephone system which is run by the government will be well illustrated in the telephone service which the English postoffice will operate in London, beginning in August. It will cover a territory of about 640 square miles, which is about the size of a field twenty-five miles square.

To Americans, perhaps the greatest interest in the Government telephone is in the rates. For $12.50 a year any one can have a telephone installed in his house. Then he will have to pay a small fee for every message that he sends. To a man whose use of the instrument is limited, this method, it is certain, will be found to be of enormous advantage. In place of the 3 pence, equivalent to 6 cents, now charged to non-subscribers, for every call of three minutes' duration, the charge in the new system will be only a penny a message, or 2 cents American money, and after a certain number of messages have been sent the charge will be reduced to half a penny each.

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Telephone Magazine

THE ONLY INDEPENDENT TELEPHONE PAPER IN THE WORLD.

TEL. CENTRAL 2841. MARQUETTE BUILDING, CHICAGO.

SUBSCRIPTION:

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Published on the 1st day of each month.

ELECTRICAL ENGINEERING PUBLISHING CO.

JOHN C. McMYNN, PRESIDENT.

No corporation, firm or person either directly or indirectly interested in the production or sale of telephones or telephone materials of any sort has any connection, editorial or proprietary, with this publication.

The Largest Independent Exchange in the World.

What will be the largest telephone exchange yet installed by the independents is now being constructed in Philadelphia by the Keystone Telephone Company, under the direction of Charles E. Wilson, the newest officer of the Independent Association of America.

The East has been slow to take up the independent movement, but when started has developed more rapidly than the West.

The next national convention will be held at Philadelphia on invitation of the Keystone Company, whose exchange will then be in operation, exhibiting, as it will, the latest improvements in the art of modern telephone construction. From an engineering standpoint we feel conservative in stating that it will be the finest exchange in the world.

A $3,000,000 Slot Machine.

The stockholders of the Central Union who had to get together and put $3,000,000 in the slot, now know how their subscribers feel when they deposit a dime for a cent's worth of service.

It is quite likely that they will fully appreciate the sentiments of the subscriber should they receive nothing but talk for their $3,000,000. Yet talk is cheap ——.

Telephone War in Baltimore.

As indicating the fierceness of the telephone war in Baltimore, it is announced that some of the companies are offering to put nickel-in-the-slot 'phones in private houses, if each patron will agree to send in one call daily and drop a nickel into the receptacle provided for that purpose. This proposition does not seem so very "fierce." Five cents a day means $18.25 in a year, which will probably cover the cost of service and leave a small margin for profit. Moreover, the telephone habit is a growing one, so many are the occasions when it is convenient to summon the hello girl; and it is altogether probable that the great majority of nickel-a-call instruments will be used so largely in excess of 365 times a year that the Baltimore companies will receive larger returns than for their house service on the annual contract plan.

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When Bell Exchanges Become Independent.

The decision of Judge Barnard in the court of last resort, given in this issue, on the right of Congress to dictate to the Chesapeake & Potomac Telephone Company the terms upon which it may remain and do business in the District of Columbia, is almost as important as the Berliner decision.

The carrying charges of the New England Telephone Company are shown to be $31 per 'phone yearly. This is the handicap that makes independent competition successful. The Chicago Telephone Company, with the money they now pay the Bell Company in royalties within the term of three years, could re-equip thruout with modern independent apparatus, giving a better service than is now possible.

The licensee craft which formerly carried the Bell exchanges on top of the water is now dragging them beneath the cruel waves of independent competition.

How long can they last?

The new president of the Central Union Telephone Company, with $6,962,100 of stock and $6,000,000 of bonds now outstanding, asks for $3,000,000 more to help float the craft which has not paid any dividends since 1896.

The Bell exchanges are too heavily water-logged to stay on top.

Is it possible to secure the anti-trust legislation that will permit some of the more progressive to become independents?

Occasionally Original.

Down in Indianapolis the Bell people have struck a new idea. A local firm of grocers has signed a contract with the Central Union Telephone Company for fifty instruments, to be placed in the homes of customers. The telephones are to be used by the customers in placing orders for groceries, and this service is to be free of charge. But should they desire to make other calls, a fee of 1 cent is charged each time.

This is a bully cheap residence rate scheme.

Chinese Telephone System.

What is said to be the only Chinese telephone system in the United States is in operation in the city of San Francisco. There are altogether about 18,000 Chinese citizens, of whom 1,500 are merchants. Of this number 270 are subscribers to the telephone.

COMPETITION TURNS THE WHEELS.

The application of the new United Telegraph, Telephone & Electric Company to the city council of Chicago for an extension of territory, in order that they may supply Chicago as well as Hyde Park with telephones, has not yet been acted upon. The company has offered to install free telephones beside those of the Chicago Telephone Company, which shall be paid for at the rate of 5 cents for each call. The officers have also offered to make rates one-half lower than those charged by the Chicago company. To meet this proposition, President John I. Sabin, of the Chicago company, has arranged a new system on the "pay-for-what-you-get" plan. The instruments are all "nickel-in-the-slot' machines, and will be for a certain amount each day. The new instruments will be in four classes. The first will be on an individual metallic circuit, and will rent for $5.50 a month. For this forty free calls will be allowed, and additional calls will be at the rate of 5 cents each. The second will be with two subscribers on the line, with a guarantee of 20 cents each day, the calls to be at the rate of 5 cents each. The third will be on ten-party lines, 5 cents a call, and 10 cents guaranteed each day; and the fourth, for residences only, where the ten-party system is used, and one call a day is to be guaranteed at the message rate of 5 cents.

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OFFICERS AND MEMBERS OF THE INDEPENDENT TELEPHONE ASSOCIATION OF AMERICA, IN ASSEMBLY AT BUFFALO, N. Y., JUNE, 1901.

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COUCH & SEELEY CO.

Among the handsome hotel displays was that of Couch & Seely. This display occupied room 72 on the third floor, Iroquois Hotel. A glance at the illustration shows the line of apparatus that was displayed. Of course this was not an attempt, as Mr. Seely said, to show their complete line, as that would take several good-sized hotel rooms. drops, together with their new listening and ringing key, with which their well-known switchboards are equipped. Mr. Elisha B. Seeley, together with Mr. Boardman, presided over the display and supplied you with fragrant weeds while you were inspecting their beautiful line of apparatus. Their cigars were up to the quality of their apparatus, and everybody knows how good that is.

THE EXHIBIT OF COUCH & SEELEY, IROQUOIS HOTEL, BUFFALO, N. Y.

In the photograph, sitting in the foreground, will be noticed their iron box telephone, which is intended to be used for fire and police service; this is very compact and complete in every detail. To the left, in the foreground, is the street railway portable telephone. This is a highly finished piece of apparatus and, considering the long-distance outfit with which it is equipped, it is very light in weight, which is a desirable feature in portable telephones. The firm also displayed section of their jacks and

MAYBERRY & HOLMES.

Mayberry & Holmes were another firm having their display located in the hotel. The illustration shows their party-line device connected onto a switchboard. This is a new firm, who are manufacturing a new device. It is something new in a party-line selective signal system and from the simplicity of the device should come into rapid use. Their display was presided over by Dr. Holmes and Mr. Mayberry. Dr. Holmes is the inventor of this system.

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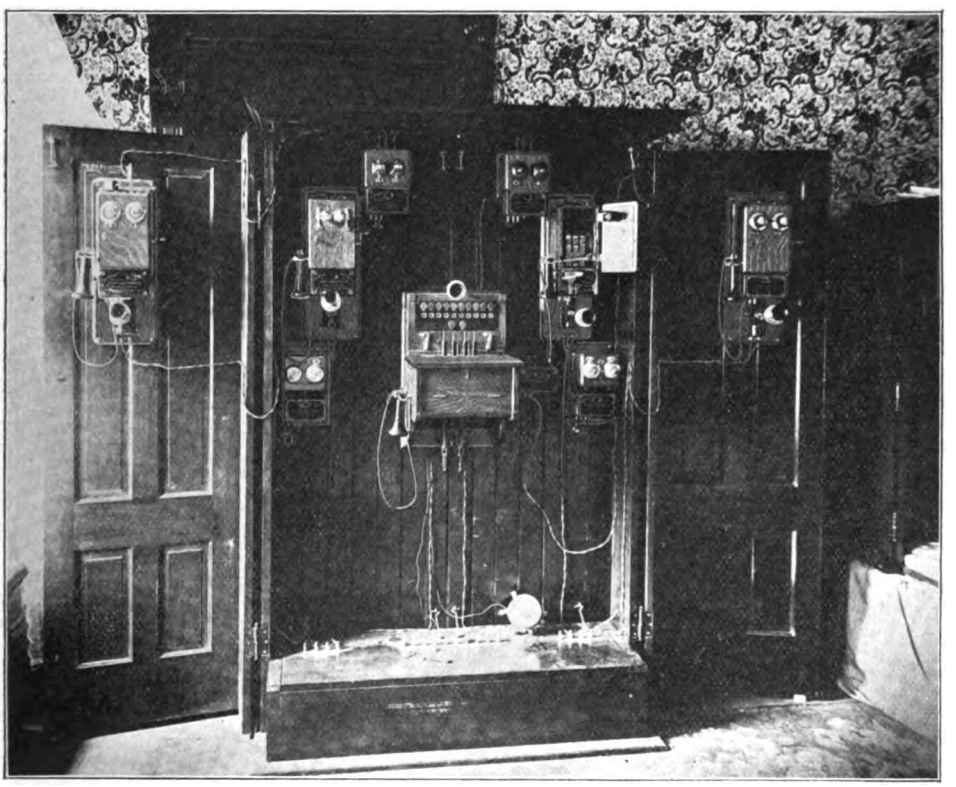
They will be glad to furnish complete information in regard to their device, upon receipt of inquiry. Their address is Boston, Massachusetts.

THE AUTOMATIC TELEPHONE METER CO.

The Automatic Telephone Meter Company secured space in the hotel and opened up its apparatus there. This company is now placing upon the market a new telephone meter which is having quite a rapid sale. Their display was presided over by Mr. Charles H. Vijjars. A description of this company's apparatus was given in THE TELEPHONE MAGAZINE of last month. This company will be pleased to submit photographs and descriptive matter upon receipt of application. Their address is Boston, Massachusetts.

AMERICAN ELECTRIC TELEPHONE COMPANY.

The grand and beautiful exhibit of this prominent company is located in the northeast corner of the Electricity building, occupying what is unanimously acknowledged to be the handsomest and most elaborate pavilion on the grounds. The space occupied is in the shape of a half octagon, giving an opportunity for displaying every corner of the pavilion to the best advantage.



THE EXHIBIT OF MAYFERRY & HOLMES, AT THE IROQUOIS HOTEL, BUFFALO, N. Y.

Our illustration gives an admirable view of the general design and the many telephone devices and apparatus on exhibition. In the immediate foreground can be seen one of the company's standard power boards, furnished with its central-energy system. On the board are mounted ammeters and voltmeters with selector switch. An I. T. E. over and under load switch, main-line

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switches, battery switches and starting and regulating rheostats, all being mounted on a slab of Tennessee marble, making all in all a most handsome piece of apparatus. The dynamotor is a 7.5-K.-W. direct coupled "Roth," transforming from 500 volts at 3 amperes to 60 volts and 25 amperes. The telephone ringer is shown immediately behind the dynamotor; it gives alternating and pulsating currents and is provided with the American Company's new automatic machine ringing attachment.

Immediately adjoining the power-board is shown a 100-line Bell-style switchboard finished in hard oak. The construction is of the well-known American, giving the highest rapidity of operation and perfect service.

A 300-line metallic cross-connecting board is seen to good advantage back of the dynamotor, while a 100-line American Express finished in an elaborate manner makes an interesting addition to the exhibit.

The 500-line Burns combined heat-coil, lightning arrester and terminal heads placed in the center of the wall attracted much attention and elicited very favorable comment from all telephone engineers and managers who took the time to give them a critical examination.

AMERICAN ELECTRIC TELEPHONE COMPANY'S EXHIBIT IN THE ELECTRICITY BUILDING, PAN-AMERICAN EXPOSITION.

In a handsome showcase facing the main aisle is displayed a most complete line of the smaller parts and accessories entering into the construction or operation of telephones and switchboards, comprising the new No. 41 desk sets in a variety of finish to meet the varying tastes of customers.

A number of new American receivers without binding-posts, showed the great

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advance made in this necessary adjunct of the telephones.

Multiple apparatus is displayed in sections showing the mechanical construction and design for magneto call, common-battery and central-energy systems.

A new device attracting much attention is the American Samson five-bar generator with improved self-contained

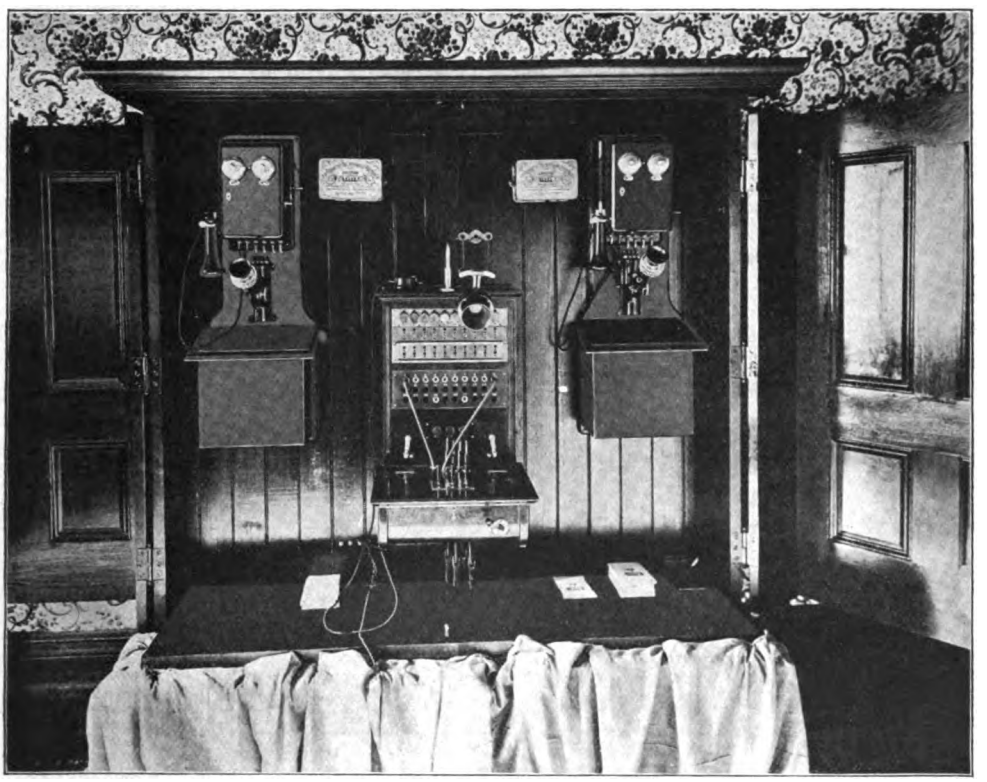

EXHIBIT OF AUTOMATIC TELEPHONE METER COMPANY, IROQUOIS HOTEL, BUFFALO, N. Y.

switch hook, mounted on metal base. This makes it impossible to get out of adjustment, as is often the case when the parts are mounted directly on wood. There is no connection thru the lever-joint, the line connection being made thru the main spring which acts as a switching device.

The display of individual lightning arresters and cable protectors is very extensive and comprises everything which is latest and best in this line.

Listening and ringing keys of different styles and designs to suit the requirements of engineers are attractively displayed. A number of elaborate and nicely finished desk telephones are prominently shown and received much favorable comment.

Attractively displayed on the wall is placed the most complete and handsome line of telephones in magneto call, centralized calling and common batteries ever seen at an exposition. The various types and designs covering the above comprise twenty-six separate and distinct patterns. One of the designs in particular which is attracting much attention is the new No. 34 central-energy telephone. The telephones are finished in antique oak, cherry, walnut and other desirable woods.

The entire design and construction of this beautiful and artistic work of art was done under the supervision of S. J. Bear, general Western agent, who also

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designed and executed the American exhibit at Omaha, and who is now in charge of the exhibit, extending to all visitors a cordial invitation to accept of the hospitality of the reception parlor on the second floor, where comfortable chairs and settees provide rest for the weary. From this balcony a very fine general view can be had of the entire

Messrs. P. J. Eubanks, Ohio representative; J. J. Speed, of the home office; C. E. Kammeyer, advertising manager, and the necessary clerical force.

Owing to the unprecedented increase in orders at the factory, the erection of the large central-energy multiple switchboard has been unfortunately delayed and could not be completed in

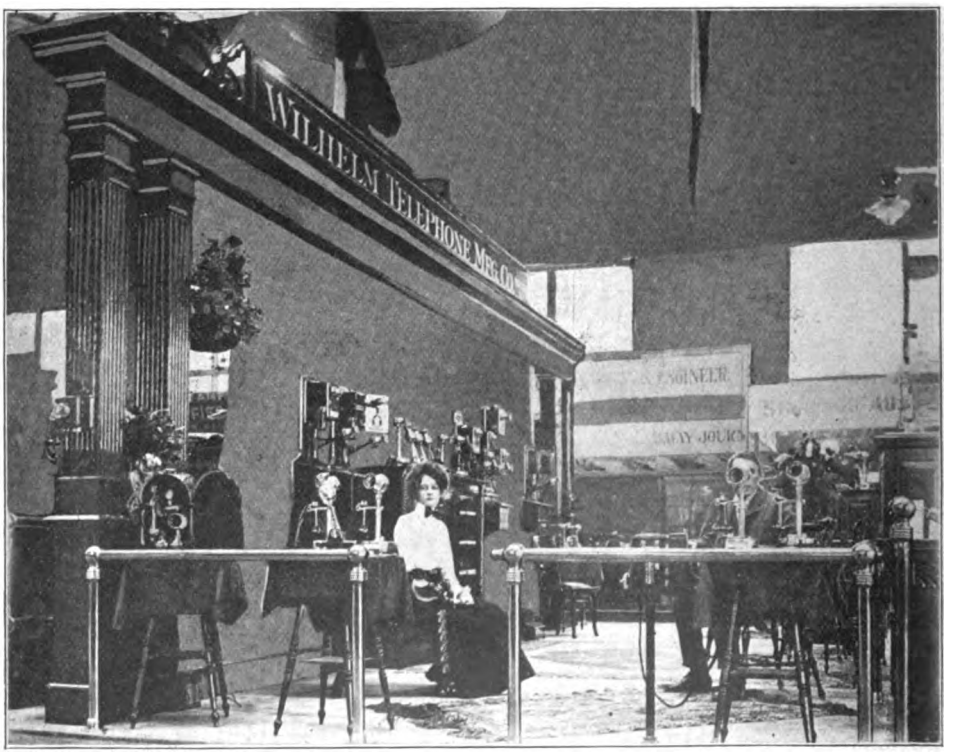

EXHIBIT OF THE WILHELM TELEPHONE MANUFACTURING COMPANY IN ELECTRICITY BUILDING, PAN-AMERICAN EXPOSITION.

electric building, including the massive electric sign, 25 by 30 feet, which in flaming letters of three feet each announces to the passing public the name of the largest telephone manufacturers in the world. In the construction of this sign 523 4-C.-P. 20-volt incandescent lamps are used, while 232 various colored lamps are necessary to the proper illumination of the pavilion.

During the convention, the staff of this well-known company, in addition to President P. C. Burns and General Manager J. G. Ihmsen, consisted of

time for the inspection of the visiting delegates.

WILHELM TELEPHONE MANUFACTURING COMPANY.

Wilhelm Telephone Manufacturing Company made its display at the Pan-American Exposition grounds in the Electricity building. This company had on display a complete line of apparatus which its obliging representative was more than willing to explain and bring forth the several merits of the Wilhelm

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apparatus. This company also had a branch office in connection with the display where it received quite a few orders for its well-known goods.

KELLOGG SWITCHBOARD AND SUPPLY COMPANY.

One of the most elaborate displays in the entire exposition is that made by the Kellogg Switchboard & Supply Company. The building is composed of white staff, supported at each corner by three massive columns of the same material. The decorations along the ledge of the tower were large desk sets. In the interior there are a number of pieces of apparatus. One that attracted a great deal of attention was a 12,000-line section, which was completely equipped and provided with multiple jacks. And by the side of this large board was placed a section of 7,200-line board completely equipped. In a special room fitted out for it there were three sections of a 3,000-line board complete in every detail; also, in this room, there were arranged around the walls telephones made up in all the finest woods. Upon entering this room there was one thing bound to attract your attention and that was one section of a 3,000-line minor board. The base-

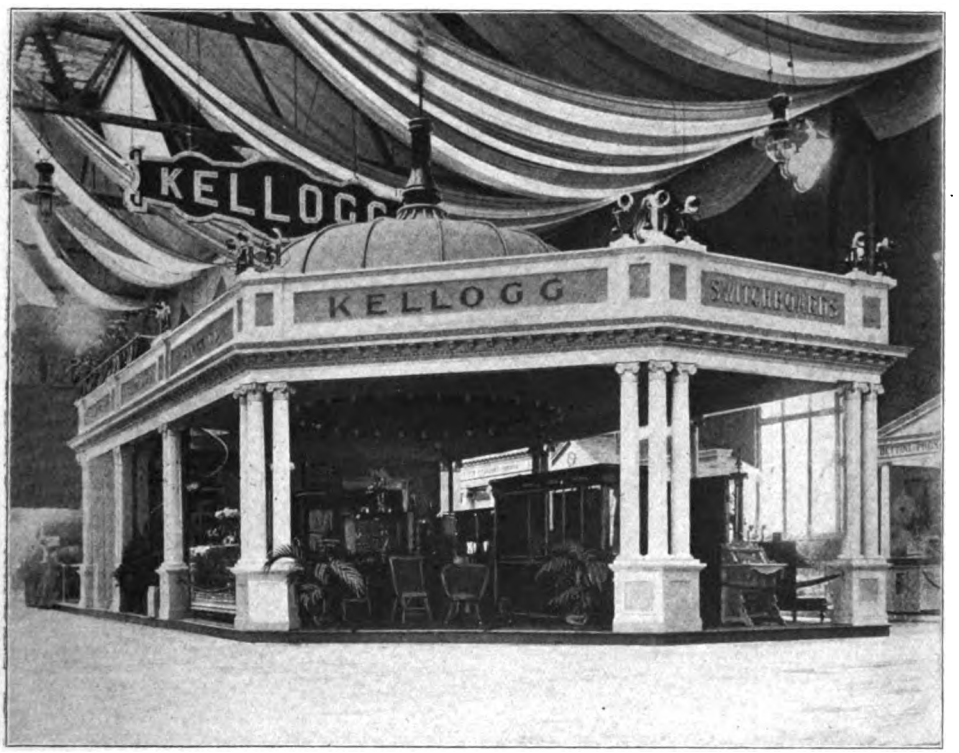

EXHIBIT OF KELLOGG SWITCHBOARD AND SUPPLY COMPANY, ELECTRICITY BUILDING, PAN-AMERICAN EXPOSITION.

ment of the exhibit had been converted into a power room and divided into two sections — one is a battery room, thoroly equipped with two sets of complete battery outfits; the other room contains the power plant. This outfit consists of two charging machines, two ringing machines, relay rack, terminal steps, together with a complete switchboard containing all instruments and switches. This exhibit in the basement attracted a great deal of attention. Upon returning up-stairs one finds placed around a great number of small boards of both

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the magneto type and central battery systems. One small board that attracted a great deal of attention was the combination board made by this company. This board is intended to be used where there is both magneto and central battery systems. It is equipped with thirty magneto lines and one hundred and eighty central battery lines. They also display something new in a cabinet

Telephone Convention held at the Iroquois Hotel on June 11, 12, 13. The excellent workmanship and design of its apparatus excited enthusiastic comments among the delegates. This exhibit consisted of two portable army field switchboards, one 40-drop regular type army board and a 100-drop combined series and bridging switchboard. The company showed further army tele-

EXHIBIT OF THE LAMBERT SCHMIDT TELEPHONE MANUFACTURING COMPANY, IROQUOIS HOTEL, BUFFALO, N. Y.

desk set and central battery 'phones. The top of the building was converted into a roof-garden for the entertainment of visitors. This display was presided over by Mr. Paul Bossart, Mr. W. W. Deen, Mr. Platt and Mr. Manson.

THE LAMBERT SCHMIDT TELEPHONE MANUFACTURING COMPANY.

The Lambert Schmidt Telephone Manufacturing Company had a very elaborate exhibit at the Independent

phone field sets, its regular exchange telephone, consisting of generator call and common battery wall telephones, portable desk telephones, micro-telephones, its automatic reset intercommunicating wall and desk sets, many combinations of private line instruments and parts in detail of the cordless adjustable arms, transmitters, receivers, etc.

The company made a particular feature of showing the inside of both switchboard and telephones, as illustrat-

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ing the fine workmanship thruout. The two army portable field switchboards attracted considerable attention, being a novelty in the line. These boards are of six and ten drops respectively. No cords or jacks are used. A short explanation of the 10-drop outfit is as follows:

All the parts are inclosed in a heavy, compact oak case with a door at the front and back. Inside, at the front, is a hard rubber panel on which is mounted in the first row ten drops, second row ten red ringing cams, third, fourth and fifth rows being composed each of ten black cross-connecting cams, and sixth row three white listening cams, and below a night-bell cam. There is one ringing cam for each line and one listening cam for each row of black cams. The cross connections on the first call would be made on the first row of black cams, using the first listening cam to the left; the second cross connection would be made on the second row of black cams, using the second listening cam, etc. The ringing on any line can be made by the individual red ringing cams. The board is provided with their army type hand microtelephone and bridging generator, and with binding posts at the top for line connections. The board weighs sixty-three pounds, is compact and can be shifted at a moment's notice. A strap at the top is used for carrying.

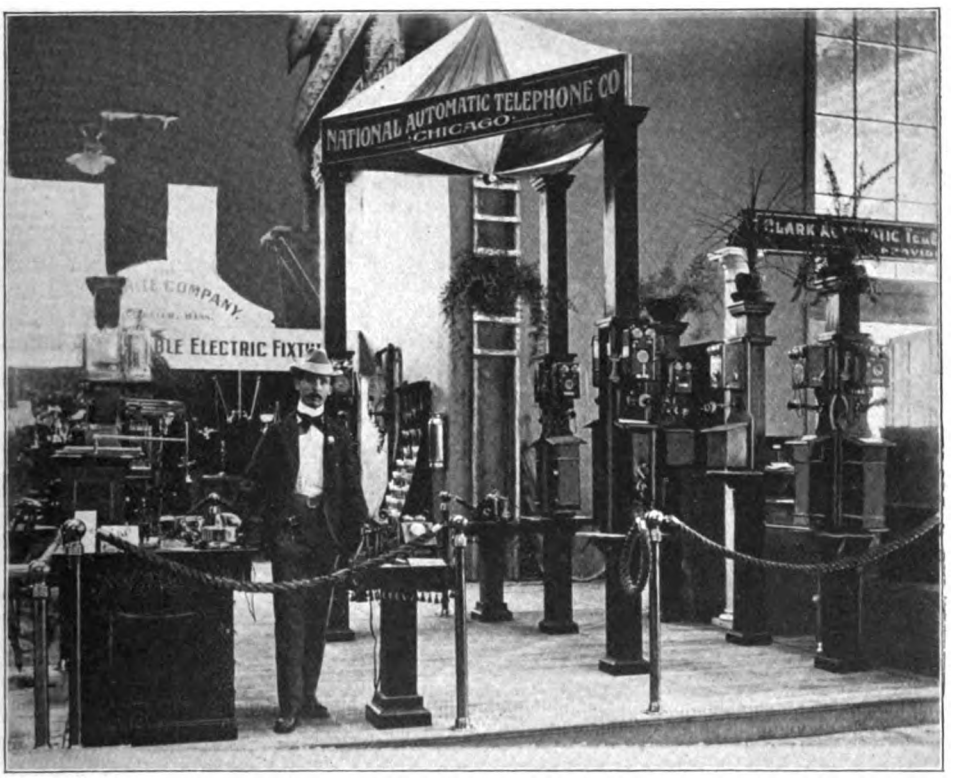

EXHIBIT OF THE NATIONAL AUTOMATIC TELEPHONE COMPANY, ELECTRICITY BUILDING, PAN-AMERICAN EXPOSITION.

The company exhibited a trick telephone in the shape of a common battery wall instrument. A delegate on being requested to try the telephone would lift the receiver from the hook, when the lid of the ringer box would fly up, showing a bunch of cigars and a notice "Take one." It is needless to

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say that the invitation was seldom refused.

The company was ably represented by Mr. Lambert Schmidt, president,

NATIONAL AUTOMATIC TELEPHONE COMPANY.

National Automatic Telephone Company, of Chicago, Illinois, has fitted up a very elaborate display on the Pan-American Exposition grounds in the Electricity building. Its genial representative, Mr. Bert Ectess, was kept quite busy during the whole convention exploiting National apparatus. This company has also something new in the selective signal party-line system, of which it will be pleased to furnish illustrations and diagrams to any interested party.

THE COMING TELEPHONIC FIGHT.

According to the statements of fiction, there was once an old lady who delighted in saying "I told you so," and was never so happy as when some prophetic utterance was justified in reality, and enabled her to use her much-loved phrase. If prophets about technical matters cared to emphasize their prophecies when fulfilled to the letter, there would often be a great cry of jubilation. In matters telephonic it has been easy for years past to prophesy, and as the years roll on, most if not all the prophecies are being fulfilled. The reason for this simple state of affairs is that from the very first the government of the day blundered, and from then to the present time it has consistently gone on blundering. The fact of the matter is, that no government has had a real policy, but has done anything at any moment when a big enough row was kicked up — that was expedient to stop the row. No government has ever assisted telephonic development toward perfection — they have been benevolently neutral when neutrality paid, they have badgered the companies when badgering paid, they took over trunk lines when public opinion required a sacrifice; they are going to compete with imperial funds, and have allowed competition with local capital, all the time taxing the receipts of those who have done what has been done in this country to develop a telephonic system. We have little sympathy with the company that has exploited this industry, because its early days were devious, though later it has been more businesslike; but we have less sympathy with the governments whose imbecility has brought about the present state of affairs. It may be that the capital employed in telephone enterprise is largely watered, yet it is certain that the majority of present holders are holders for value given, and the management is bound to fight tooth and nail in their interests. Tunbridge Wells, of course, is the latest text. Here we find a local authority and a company competing, the former with capital borrowed upon the security of the rates to foster a concern that may peter out in the course of ten years or so, when a parsimonious government may follow the way of the Dutch by giving too little and taking too much. The absurdity of the municipal trading mania will be brought home to some of those who embark in it before long, for competition will lead to straits never contemplated by wire-pullers — and rate-payers will prove human. Who, outside of a lunatic asylum, ever imagined that the company would give up its business without a tussle? And a little investigation will show that it is in a better position to fight more of the municipalities than the municipalities are to fight the company. A business man with ten shops in different places can better afford to cut prices at one shop against a competitor, than that competitor can, working with borrowed capital and only one shop. In the abstract, no doubt the view of local centers and trunk lines is fascinating, and such a system might be admirable provided there was no other system in existence. Hitherto the majority of people have schemed as if no telephone company was in existence, and only now realize that the company is a factor in the case, and can put an effective spoke in the wheel by lowering its prices. — *From the London Electrical Engineer, July 5.*

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WHO WAS THERE AND WHO AND WHAT THEY REPRESENTED.

Mr. W. A. Hopkins was present at the convention and represented the Erner Hopkins Company, of Columbus, Ohio.

The Utica Fire Alarm Company, of Utica, New York, sent Mr. S. J. Lambridge in their behalf.

Mr. Harry Hipwell, of the Hipwell Manufacturing Company, together with his brother, ran down from Allegheny, and were busily engaged distributing among their many friends and customers their handsome souvenir — a pen-holder. This will enable their customers to now write their orders in ink and enable their friends to use more of their good material.

Mr. Harry P. Moore, representing the Chase-Shawmut Company, came on from the East.

Mr. P. H. Hover was on hand representing the New York Insulated Wire Company.

Mr. Bleeker S. Barnard distributed cards of the American Vitrified Conduit Company.

The Gilliland Electric Company sent Mr. Frank B. Jones as a representative from Adrian, Michigan.

Mr. J. B. Honan was a trustworthy representative for the National Conduit and Cable Company, of New York city.

Mr. Raymond Hendrickson represented the North Electric Company, of Cleveland, Ohio.

The American Electric Fuse Company sent Frank G. Jones and James A. Kenny as representatives, and they were generous in their courtesies to the delegates.

Mr. E. H. Hammond was the man to represent the American Electrical Works from the Chicago office.

Mr. G. Hallet Johnson was there, distributing a booklet of the apparatus manufactured by the International Supply Company, of Chicago, exploiting the Schwartz telephones.

Mr. W. S. Paca, electrical engineer of the Union Switchboard Company, Erie, Pennsylvania, accompanied by Mrs. Paca and John C. Miller, was in attendance at the convention.

Mr. Smith, of the Smith-Hemenway Company, was kept busy explaining the Ericsson telephone apparatus, which is handled by the Smith-Hemenway Company, New York.

Mr. Overshiner, of the Swedish-American Telephone Company, of Chicago, after getting up the schedule of the "Prairie Special," for some reason was not in attendance, but general manager Macklin was on hand distributing some of those remarkable time-tables.

"Joe" Williams, president of the Williams Electric Company, well deserves the popularity he has won. He reports an increase of business at the present time.

Mr. Otto E. Osthoff, from Chicago, representing the Electric Storage Battery Company, of Philadelphia, did the honors of that company.

The Stromberg-Carlson Manufacturing Company was represented by Mr. A. Stromberg, C. W. Stinger, H. Shaffer, E. L. Brown, William Davis, Paul M. Krahmer, P. J. Hertz and S. Curtis. The list of representatives is in proportion to the size of the company and the volume of its business.

W. J. Murdock & Co., of Chelsea, Massachusetts, were represented by Mr. Murdock himself. He distributed a souvenir telephone receiver almost large enough for regular service.

President Bowman, of the Western Telephone Construction Company, was there. No one who was present at the convention could help but notice the smiling countenance of the president of the company. Mr. Bowman is all he looks to be and a fine fellow.

Mr. Harding, of the Holtzer-Cabot Company, together with those Holtzer-Cabot "Butterflies," which got stuck on you whether or not you got stuck on them, was also present.

The Monarch Fire Appliance Company showed good form when it sent Gen. C. Barney. General Barney, as usual, had something interesting in a pamphlet telling the merits of Kilfyre.

The Automatic Telephone Meter Company, of Boston, Massachusetts, exhibited for the first time an automatic telephone meter, which it is claimed furnished a solution of the measured-serv-

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ice problem. Charles A. Viggars explained to all the merits of the device.

The Electric Appliance Company put in appearance and sent S. L. Dinsmore and A. L. Millard. The representatives of this company kept the delegates fully aware that their company has a large stock of telephone apparatus.

President L. Sands, of the Williams-Abbott Company, of Cleveland, as is his custom, was "one of the boys."

The Sumter Telephone Manufacturing Company, of Sumter, South Carolina, was represented by F. C. Manning. He is a clever fellow and has clever goods from the South.

Valentine-Clark Company sent Mr. Clark. Valentine and Clark are two young men who have, by their energetic efforts, won a place in the independent field.

Mr. H. J. Kusel, vice-president and general manager of the Eureka Electric Company, of Chicago, as usual was on hand and was not afraid of the delegates. Mr. Arthur Stein and family were also present, altho hardly any one saw them. Mr. George B. Pratt, Eastern representative of the Eureka Electric Company, was at the convention.

The McRoy Clay Works, of course, had Manager E. F. Kirkpatric at the convention to represent that company. He is always rated as being a good fellow.

The Varley-Duplex Magnet Company had Western Manager Hibbard to represent it. Every one was looking for President Varley, but as the company at Phillipsdale, Rhode Island, was very busy, the president could not be spared.

Mr. E. B. Seeley and A. F. Boardman represented Couch & Seeley, of Boston. Mr. Seeley attempted to get acquainted and to pass around good cigars, which were as good as their 'phones are. Mr. Boardman, it will be remembered, was one of the defenders in the famous Berliner case. Mr. Boardman looks every inch the man that made that fight to the finish.

Mr. Charles A. Rolfe, of the Rolfe Electric Company, was present with his wife and a pleasant word for all.

The Central Telephone & Electric Company had its president, "Jim" Cuming, representing it, and when you see him it is a case of "Hello Central." The company is doing a fine business and all due to Mr. Cuming.

The Kellogg Switchboard & Supply Company had President Milo G. Kellogg, Frank J. Dommerque, Stanly A. Duvall, P. W. Bossart, A. E. Barker, S. C. Platt, A. J. Rousseau, George Burlingame, R. H. Manson, H. J. Webster, C. L. Meyer and Mr. Wheeler. This company had its exhibit at the Pan-American grounds in the Electricity building.

Mr. P. C. Burns, president of the American Electric Telephone Company, of Chicago, of course was in attendance. A convention without Mr. Burns' attendance would be indeed out of the regular order. Mr. Burns was accompanied by General Manager Ihmsen, Advertising Manager Kammeyer and Representative Speed.

The Lambert Schmidt Telephone Company, of New York, had a large display in room 80. There were also W. W. Bostrick and Paul Schratz to represent this company. One of its instruments caused much amusement, for when a subscriber attempted to ring up Central it would offer you a cigar in a most polite manner. It is hardly necessary to say that the cigars were accepted.

The Miller-Knoblock Manufacturing Company, of South Bend, Indiana, was represented by Mr. O. M. Knoblock.

Mr. C. E. Egan, general manager of the Durham Telephone Manufacturing Company, Durham, North Carolina, attended in behalf of his company.

Mr. G. A. Roth was on hand to represent Roth Bros. & Co., Chicago.

Mr. F. W. Wilcox, of the General Electric Company, Harrison, New Jersey, attended to ascertain the wants of the telephone men and incidentally display a miniature lamp signal that he carried in his vest pocket.

Messrs. W. Bissell, M. S. Walker and C. H. Hamilton, of Toledo, Ohio, attended to represent F. Bissell & Co.

The Central Electric Company, of Chicago, was represented by Mr. Allen T. Pearl.

Mr. J. Putman, together with Messrs.

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Stillings and T. Ingraham, were also present, representing the Clark Automatic Telephone Switchboard Company, of Providence, Rhode Island.

The American Miniature and Decorative Lamp Company, of New York city, had Mr. H. J. Jaeger on hand to look after its interests.

Dr. W. M. Habirshaw attended to represent the India Rubber & Gutta-Percha Insulating Company.

Mr. J. F. Kerlin, of Kokomo, Indiana, attended in behalf of the Laclede Battery Company.

Mr. J. A. Russell did the honors for the National Automatic Telephone Company of Chicago.

Mr. George T. Manson, of New York, looked after the interests of the Okonite Company.

Mr. W. N. Slughiff, of Chicago, Mr. W. G. Quigley, of Trenton, New Jersey, Mr. W. T. Bowman, of Cleveland, Ohio, and Mr. G. W. Swann, composed an able staff to represent John A. Roebling's Sons Company.

Messrs. W. E. Doolittle and F. B. Cook were in attendance to represent the Sterling Electric Company, of Lafayette, Indiana.

The Standard Underground Cable Company had on hand Mr. J. R. Wiley, of Chicago, T. E. Hughes, of Philadelphia, C. L. Wiley, of New York, and A. V. Sauerman, of Boston, to look after its interests.

Mr. Barnard attended to represent the American Vitrified Conduit Company.

Mr. H. B. Moore was on hand representing the Chase-Shawmut Company, of Boston, Massachusetts.

Mr. McDonald, of Muncie, Indiana, represented the Wagner Electric Company.

Messrs. W. A. Foss and Mr. Kaneen, of the American Toll Telephone Company, Cleveland, Ohio, were around making a great many friends. Next time you meet them they will show you how it is done.

The Eastern Automatic Telephone Company, of Boston, Massachusetts, was represented by Messrs. Vinton and Sears.

One of the very nice hotel exhibits, of which we regret we were unable to get a photograph, was that made by the Columbia Telephone & Electric Company. This company exhibited the new devices which are the ideas of Mr. James Nolan. It has a new departure in a switchboard, of which; thru the kindness of the above-named gentlemen, we will be able to give a complete description of next month. Many of Mr. Nolan's old friends were glad to see him at the convention, for Jim is "a hail fellow well met."

The display of the Swedish-American Telephone Company on the parlor floor of the Hotel Iroquois was one of the most elaborate hotel displays made at the convention, and was presided over by General Manager Mr. C. H. Macklin, with the assistance of Mr. A. Overshiner.

IN ATTENDANCE.

Adely, W. F., Boston, Mass.
Allison, Price A., American Electric Fuse Company, Chicago, Ill.
Anderson, E. S., United States Telephone Company, Dunkirk, Ohio.
Atchison, H. F., G. F. Atchison Company, Jersey City, N. J.
Babcock, W. F., Rochester Telephone Company, Rochester, N. Y.
Babtiste, C. A., New York.
Barber Ed L., Central Construction Company, Wauseon, Ohio.
Barkdull, W. R., Bowling Green Telephone Company, Bowling Green, Ohio.
Barker, A. E., Kellogg Switchboard & Supply Company, Cleveland, Ohio.
Barney, C. H., Monarch Fire Appliance Company, New York, N. Y.
Barr, W. J., Cleveland, Ohio.
Belanger, J. T., Galion Telephone Company, Galion, Ohio.
Bellering, J. S., Knoxville Electric Company, Knoxville, Iowa.
Bissell, W. S., F. Bissell Company, Toledo, Ohio.
Black, T. F., and wife, Mansfield, Ohio.
Blaisdell, A. L., Elk Telephone & Telegraph Company, St. Mary's, Ohio.
Blount, R. F., Home Telephone Company, Wabash, Ind.
Blyth, B. W., Galion Telephone Company, Galion, Ohio.

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Boardman, A. F., Couch-Seeley Company, Boston, Mass.
Bowman, W. T., John A. Roebling's Sons Company, Cleveland, Ohio.
Bowman, L. G., Western Telephone Construction Company, Chicago, Ill.
Brown, Eugene F., Stromberg-Carlson Telephone Manufacturing Company, Beaver, Pa.
Brown, Clarence C., TELEPHONE MAGAZINE, Chicago, Ill.
Buckley, W. J., TELEPHONE MAGAZINE, Chicago, Ill.
Burleigh, I., Eastern Telephone & Telegraph Company, Camden, N. J.
Butler, W. H., Kent Home Telephone Company, Kent, Ohio.
Carson, B. L., Valley Telephone Company, Bay City, Mich.
Cary, W. L., Jr., United States Telephone Company, Cleveland, Ohio.
Child, Charles T., *Electrical Review*, New York, N. Y.
Coen, Nellie, Federal Telephone Company, Cleveland, Ohio.
Coit, Henry A., St. Louis, Mo.
Collins, W. Forman, *Western Electrician*, Chicago, Ill.
Conde, S. B., Jr., S. B. Conde, Jr., Company, Boston, Mass.
Conover, George W., North Electric Company, Chicago, Ill.
Cook, Frank B., Sterling Electric Company, Lafayette, Ind.
Coontz, W. H., Cleveland, Ohio.
Cravath, J. R., *Electrical World and Engineer*, Chicago, Ill.
Crom, C. T., Galion Telephone Company, Galion, Ohio.
Cummings, W. K., Wellsburg Telephone Company, Wellsburg, W. Va.
Curtis, Carl C., Sandusky Telephone Company, Sandusky, Ohio.
Davis, A. M., Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill.
Davis, Mark, Cuyahoga Telephone Company, Cleveland, Ohio.
De Land, Fred, Federal Telephone Company, Pittsburg, Pa.
Dinsmore, S. A., Electric Appliance Company, Chicago, Ill.
Doolittle, W. E., Sterling Electric Company, Lafayette, Indiana.
Doyle, W. L., S. B. Conde, Jr., Company, Trenton, N. J.
Dommerque, F. J., Chicago, Ill.
Doyle, H. J., Monarch Fire Appliance Company, New York, N. Y.
Durin, W. H., Cedar Rapids, Iowa.
Edwards, J. S. G., Johnstown, N. Y.
Enwright, R. C., Federal Telephone Company, Cleveland, Ohio.
Fair, George W., Fair Telephone Company, Chrisman, Ill.
Firmin, John C., Findlay, Ohio.
Fisher, C. L., Findlay, Ohio.
Fitzgerald, James J., Cuyahoga Telephone Company, Cleveland, Ohio.
Fledderjohn, W. H., Inland Telephone Company, New Knoxville, Ohio.
Fledderjohn, Edwin, Inland Telephone Company, De Graff, Ohio.
Ford, J. B., Ontario Telephone Company, Toronto, Ont.
Foss, W. A., American Toll Telephone Company, Cleveland, Ohio.
Fox, H. W., Indianapolis, Ind.
Fralich, R. R., Federal Telephone Company, Pittsburg, Pa.
French, O. F., Federal Telephone Company, Cleveland, Ohio.
Geiger, Amos A., Bluffton, Ohio.
Gilmore, Tiffin, United States Telephone Company, Cleveland, Ohio.
Goddard, Stephen H., *Electrical Review*, New York city.
Goss, John D., Johnson County Telephone Company, Iowa City, Iowa.
Gott, C. D., Black River Telephone Company, Lorain, Ohio.
Gowe, H. S., Portsmouth Telephone Company, Portsmouth, Ohio.
Gradolph, F. W., Ottawa County Telephone County, Oak Harbor, Ohio.
Granel, C. M., Painesville, Ohio.
Granger, Sherman M., Zanesville Telephone & Telegraph Company, Zanesville, Ohio.
Hagerman, A. V., Black River Telephone Company, Lorain, Ohio.
Hall, Newton, *Electrical Age*, New York, N. Y.
Hamilton, C. M., F. Bissell Company, Toledo, Ohio.
Hammond, E. H., American Electrical Works, Chicago, Ill.
Harding, E. R., Holser-Cabot Electric Company, Chicago, Ill.
Harris, C. O., Rochester Telephone Company, Rochester, N. Y.
Hendrickson, R., Macedene, N. Y.

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Hayden, Virgin, Cattaragus Telephone Company, Franklinville, N. Y.
Helferstein, J. P., Juniata & Susquehanna Telephone Company, Shamokin, Pa.
Hertz, P. J., Chicago, Ill.
Hibbard, C. L., Varley Duplex Magnet Company, Chicago, Ill.
Hipskind, John, Home Telephone Company, Wabash, Ind.
Hoffman, George J., Tuscarawas County Telephone Company, Cleveland, Ohio.
Holland, Russel, *Electrical Review*, New York, N. Y.
Holland, W. H., Holser-Cabot Electric Company, Brookline, Mass.
Holloway, W. S., Massillon Telephone Company, Massillon, Ohio.
Honan, J. B., National Conduit & Cable Company, New York, N. Y.
Hopkins, William A., Erner, Hopkins Company, Columbus, Ohio.
House, E. L., Painesville Telephone Company, Painesville, Ohio.
Howk, C. L., People's Telephone Company, Shelby, Ohio.
Hughes, T. E., Standard Underground Cable Company, Philadelphia, Pa.
Hughes, William, York Telephone Company, York, Pa.
Hyde, E. W., Jefferson & Warren Telephone Company, Orangeville, Ohio.
Ihmsen, J. G., American Electric Telephone Company, Chicago, Ill.
Inspector, The, TELEPHONE MAGAZINE, Chicago, Ill.
Jaeger, H. J., American Miniature and Ber. Lamp Company, New York.
Johnson, G. Hallett, International Specialty Company, Chicago, Ill.
Johnston, W. J., New York city.
Jones, Frank E., American Electric Telephone Company, Chicago, Ill.
Jones, W. H., Cortland Home Telephone Company, Cortland, N. Y.
Judd, R. W., Federal Telephone Company, Cleveland, Ohio.
Judson, C. H., Twin City Telephone Company, Minneapolis, Minn.
Juperon, George S., Cleveland, Ohio.
Juvenall, C. D., Upper Sandusky Telephone Company, Upper Sandusky, Ohio.
Kammeyer, C. E., American Electric Telephone Company, Chicago, Ill.
Keily, W. E., *Western Electrician*, Chicago, Ill.
Kenney, J. A., American Electric Fuse Company, Chicago, Ill.
Kerlin, J. F., Laclede Battery Company, Kokomo, Ind.
Knierim, T. M., Toledo, Ohio.
Knoblock, Otto M., Miller-Knoblock Manufacturing Company, South Bend, Ind.
Koontz, Charles E., Bremen Telephone Company, Bremen, Ind.
Kusel, A. J., TELEPHONE MAGAZINE, Chicago, Ill.
Lancaster, L. H., Louisiana & Texas Long-Distance Telephone Company, Thibodaux, La.
Lee, Thomas B., Pittsburg, Pa.
Liggett, N. E., Marysville Telephone Company, Marysville, Ohio.
Lunbridge, S. J., Utica Fire Alarm Telegraph Company, Utica, N. Y.
McConehay, C. D., Anderson Telephone Company, Anderson, Ind.
McDonald, C. M., Wagner Electric Company, Muncie, Ind.
McJarlan, Hyde, Hubbard City Telephone Company, Hubbard City, Tex.
McVey, C. Y., Youngstown Telephone Company, Youngstown, Ohio.
Malery, A. B., Kent Home Telephone Company, Kent, Ohio.
Manson, George T., Okonite Company, New York, N. Y.
Martin, William, Cortland Home Telephone Company, Cortland, N. Y.
Martin, T. C., *Electrical World and Engineer*, New York, N. Y.
Martin, K. G., *Electrical World and Engineer*, New York, N. Y.
Mayberry, T. E., Mayberry Home Party Line System, West Bedford, Mass.
Mengab, L. C., and wife, Mansfield, Ohio.
Meyers, Charles L., Kellogg Switchboard & Supply Company, Chicago.
Millard, O. L., Electric Appliance Company, Chicago, Ill.
Miller, Otto, Federal Telephone Company, Cleveland, Ohio.
Miller, John J., Union Switchboard Company, Erie, Pa.
Moore, H. P., Chase-Shawmut Company, Boston, Mass.
Morrison, G., Morrison Telephone Company, Greenfield, Ind.

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Mitchell, Robert, Bluffton, Ohio.
Morron, Will, Columbiana County Telephone Company, Lisbon, Ohio.
Moulton, I. H., La Crosse, Wis.
Murch, Maynard H., Jr., Cleveland, Ohio.
Murdock, William J., William Murdock & Co., Chelsea, Mass.
Murry, Kennett V., United States Telephone Company, Cleveland, Ohio.
Numan, Thomas W., Portsmouth Telephone Company, Portsmouth, Ohio.
Osthoff, Otto E., Electric Storage Battery Company, Chicago, Ill.
Painter, J. B., West Pennsylvania Telephone Company, Independence, Pa.
Patten, W. G., Louisville, Home Telephone Company, Louisville, Ky.
Pear, Allen S., Central Electric Company, Chicago, Ill.
Perry, Frank L., *Western Electrician,* Chicago, Ill.
Pierce, F. W., Madison-Clark Telephone Company, London, Ohio.
Pierce, John, Federal Telephone Company, Cleveland, Ohio.
Pratt, George B., Eureka Electric Company, Buffalo, N. Y.
Presson, A. T., Johnson County Telephone Company, Iowa City, Iowa.
Price, H. A., Valley Telephone Company, Bay City, Mich.
Putnam, J. L., Clark Automatic Telephone Company, Providence, R. I.
Pyke, Dr. A. D., Tippecanoe Telephone Company, Romney, Ind.
Quigley, W. G., John A. Roebling's Sons Company, Trenton, N. J.
Rhodes, J. B., Zanesville Telephone & Telegraph Company, Zanesville, Ohio.
Risser, J. F., Putnam Telephone Company, Ottawa, Ohio.
Rolfe, Charles A., Rolfe Electric Company, Chicago, Ill.
Ross, O. J., United States Telephone Company, Cleveland, Ohio.
Rotchka, F. E., *Western Electrician,* Chicago, Ill.
Roth, G. A., Roth Bros. & Co., Chicago.
Rudy, G. W., York Telephone Company, York, Pa.
Sands, L., Williams-Abbot Electric Company, Cleveland, Ohio.
Sapp, Miss Bertha, Southern Telephone Company, Nashville, Tenn.
Sapp, F. F., and wife, Southern Telephone Telephone Company, Nashville, Tenn.
Sauerman, A. V., Standard Underground Cable Company, Boston, Mass.
Schapfer, John H., J. Edward Ogden Company, New York, N. Y.
Scofield, John H., New York, N. Y.
Scholl, A. G., Juniata & Susquehanna Telephone Company, Mifflintown, Pa.
Scott, P. D., Lesto, Ont., Phœnix Electric Telephone Company, New York, N. Y.
Sears, Vinton H., Eastern Automatic Telephone Company, Boston, Mass.
Seaton, W. B., Citizens' Telephone Company, Ashland, Ky.
Sleinkamp, J. G., Ottawa County Telephone Company, Elmore, Ohio.
Slugluff, W. N., John A. Roebling's Sons Company, Chicago, Ill.
Smith, H. L., Cortland Home Telephone Company, Cortland, N. Y.
Snyder, J. D., Findlay, Ohio.
Speed, J. J., American Electric Telephone Company, Chicago, Ill.
Stevens, Charles G., Chicago, Ill.
Stiger, C. W., Stromberg-Carlson Telephone Manufacturing Company, Chicago, Ill.
Stromberg, Alfred, Chicago, Ill.
Strong, S. M., Akron People's Telephone Company, Akron, Ohio.
Swan, G. W., New York city.
Taylor, H. K., Federal Telephone Company, Cleveland, Ohio.
Taylor, E. C., Findlay, Ohio.
Taylor, E., Syracuse, N. Y.
Taylor, H. A., Lafayette Telephone Company, Lafayette, Ind.
Taylor, A. M., Cleveland, Ohio.
Trier, George F., National Telephone & Telegraph Company, Fort Wayne, Ind.
Viggeles, Charles W., Automatic Telephone Meter Company, Boston, Mass.
Wakeman, Edward J., TELEPHONE MAGAZINE, Chicago, Ill.
Walker, Edward T., *Electrical World and Engineer,* Boston, Mass.
Walker, M. S., F. Bissell Company, Toledo, Ohio.
Warner, T. W., and wife, *Electrical World and Engineer,* Muncie, Ind.

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Weil, Samuel, Youngstown Telephone Company, Youngstown, Ohio.
Whitney, A. A., Morrow County Telephone Company, Mount Gilead, Ohio.
Wiley, J. R., Standard Underground Cable Company, Chicago, Ill.
Wiley, G. L., Standard Underground Cable Company, New York, N. Y.
Willcox, F. W., General Electric Company, Harrison, N. Y.
Williams, J. A., Williams Electric Company, Cleveland, Ohio.
Woodbury, W. B., Federal Telephone Company, Cleveland, Ohio.
Woodman, H. E., Burlington County Telephone Company, Mount Holly, N. J.
Worstall, A. M., Interstate Telephone Company, Philadelphia, Pa.
Young, H. C., Columbia Telephone Company, Columbia, Pa.
Zuvern, George T., Marysville Telephone Company, Marysville, Ohio.
Zuver, Minnie E., Federal Telephone Company, Cleveland, Ohio.

Exchanges were represented by the following:

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Cuyahoga Telephone Company, Cleveland, Ohio — J. J. Fitzgerald, M. Davis, L. W. Stanton.

United States Telephone Company, Cleveland, Ohio —T. Gilmore, W. L. Cary, Jr., K. V. Murry, C. J. Ross, H. D. Critchfield, J. M. Thomas.

Federal Telephone Company, Cleveland —J. Pierce, W. B. Woodbury, R. R. Fralich, N. Coen, M. E. Zuber, O. Miller, O. F. French, H. K. Taylor, R. W. Judd, G. S. Duperow, R. C. Enwright.

Eastern Telephone & Telegraph Company, Camden, N. J.— G. W. Burleigh.

Wellsburg (W. Va.) Telephone Company —W. K. Cummings.

Juniata & Susquehanna Telephone Company —A. G. Scholl.

Interstate Telephone & Telegraph Company —J. P. Helfenstein.

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Inland Telephone Company, New Knoxville, Ohio —W. H. Fledderjohn.

Inland Telephone Company, De Graff, Ohio — E. Fledderjohn.

People's Telephone Company, Akron, Ohio — S. M. Strong.

Galion Telephone Company, Galion, Ohio —J. T. Belanger, B. W. Blyth, C. T. Crim.

Cattaraugus Telephone Company, Franklinsville, N. Y.—V. Haydon.

Interstate Telephone Company, Philadelphia —A. M. Worstall.

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Telephone Company of America, Washington, D. C.— R. B. Hazlett.

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Western Electrician — Mr. Frank Perry, Mr. P. Rotchka and Mr. Craddler.

Electrical World and Engineer — Mr. T. C. Martin, J. R. Crabath, Mr. J. M. Wakeman, Mr. J. B. Church and Mr. E. T. Walker.

Electrical Review — Mr. M. H. Murch and several gentlemen of the editorial staff.

Telephony — Mr. Harry B. McMeal and Mr. Chambers.

The American Telephone Journal — Mr. McDonahue.

THE TELEPHONE MAGAZINE — Mr. W. J. Buckley, Mr. Clarence C. Brown, Mr. Edward J. Wakeman, The Inspector and Mr. A. J. Kusel.

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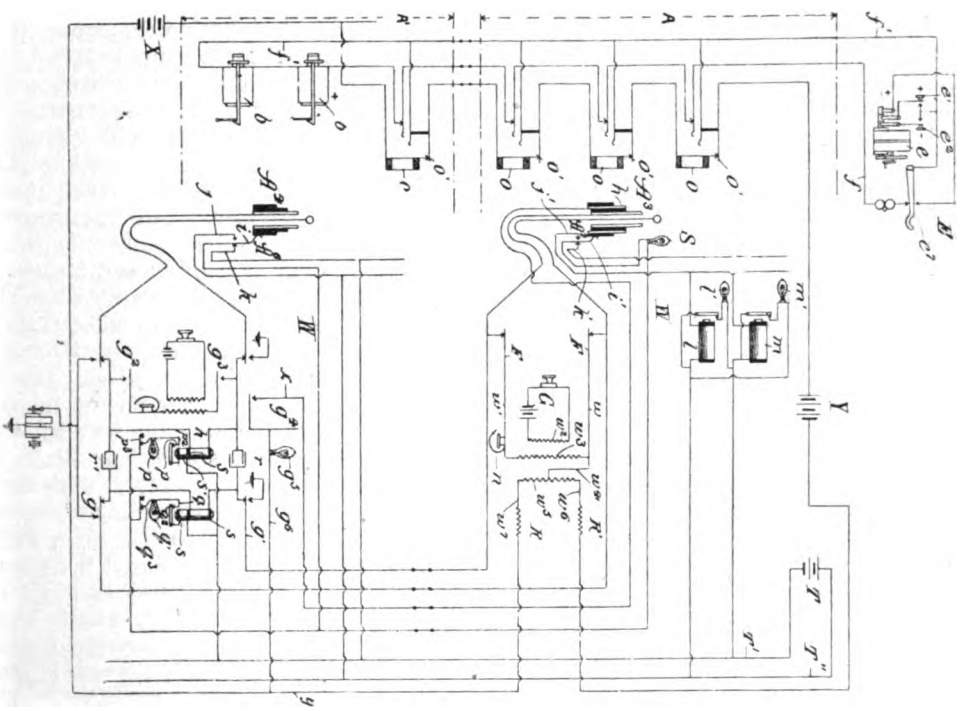
MONTHLY DIGEST OF TELEPHONE AND KINDRED PATENTS

EDITED BY CLARENCE C. BROWN.

Copies may be had, postage paid, by enclosing 5 cents for each one. Address inquiries in care of this magazine or Washington, D. C.

ERNEST E. YAXLEY, CHICAGO, ILLINOIS, AND CHARLES C. CADDEN, CLEVELAND, OHIO. IMPROVEMENT OF MULTIPLE BOARD. No. 674,807. MAY 21, 1901.

Referring to the drawing, E denotes a subscriber's station equipped with a set of push-buttons (indicated as e e^2) for calling, and a generator indicated at e adapted to deliver positive and negative pulsating currents and an alternating current. The circuits are so arranged that by pressing a push-button, as e, a positive pulsating current is sent over the wire f f, and by pressing the other button e^2, a negative pulsating current is sent, while if the generator e be operated with the hook (shown at e^7) up, an alternating current is sent over the wire. One side, f, of the circuit leads thru the contacts of the jacks on the multiple board (indicated at A), then thru the contacts of the jacks on the answering board (indicated at A), and thru the two polarized signals (indicated at b b) in series. The return side, f, of the circuit leads thru the switchboards connecting with the sleeve contacts of the jacks on the answering and multiple board jacks and thence to the line. Thus by manipulating the proper push-button at the subscriber's station and operating the generator, either one of the polarized signals may be displayed at will. In the circuit of the plug A^4 at the answering board A are a ringing key g g and a listening key g^2 g^3, with the well-known connections shown, but with the addition to the listening key of an extra contact g^4 insulated from the listening and ringing



No. 674,807.

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contacts and having a lamp or other signal g^5 in circuit with it, and connections to a battery wire y and the signal wire x, which latter terminates in the sleeve h of the plug A^3. The plug A^4 is associated with a socket switch (indicated at A^6) consisting of a movable member i connected to a signal wire W, a contact j connected with the positive pole of a battery T, and a contact k, connected with the negative pole of that battery. The plug A^3 is similarly associated with a socket switch (indicated at A^7), consisting of a movable member i connected with the signal wire W thru a signal S, and two contacts j and k. The contact j is connected with a pilot relay l, controlling a lamp signal l, and with the positive pole of the battery T, and the contact k is connected with the negative pole of said battery thru a pilot relay m, controlling a lamp signal m. The tip and the ring contacts of each plug are connected in the usual way, and in the circuits of the calling board A is included a test key F F, which is wired as follows: From the two contacts at F F, which are adapted to be connected with the respective sides of the line, wires w w lead to the secondary, w^3, of the operator's induction coil and the head-receiver n in series, and by a branch w^4 to the middle of the test winding w, which is in inductive relation to the secondary. A transmitter circuit G is arranged with the primary winding w^2 in the usual way. From the ends of the test coil u^5, wires u^6 and u^7 lead thru resistances R and R, which should be regulatable, respectively, to the positive poles to test batteries X and Y. The test circuit of the line is taken from the negative pole of the battery Y thru the contacts and the test pieces o of the jack on the board A and A in series to the negative pole of the battery X. The signal m, controlled by the pilot relay m, and the signal l, controlled by the pilot relay l, are each supplied by the mains T and T^2 of battery T, which also supplies relays p and q controlling clear-out signals (indicated at p and q). At the answering board A the trunk is divided into two parts by condensers (indicated at r and r) connected in series with the line. The relays p and q are provided each with a line coil s and an auxiliary coil s. The line-coils are in bridge connection across the line, one in each part, as indicated, and the auxiliary coils are connected to the battery mains T and the wire W thru the relay contacts p^2 and q^3, respectively, the corresponding signals p and q, contacts p^3 and q^3, the signal wire W, and the contacts j and j. The operation is as follows:

A subscriber intending to call another, first ascertains the class, as "A" or "B," and the number therein of the subscriber he wishes to call. If the subscriber wanted is, say, in the "A" class, the calling subscriber presses the proper button e' on his instrument and turns the generator crank. This throws the polarized drop b, designating the group of trunks A^2 on the answering board A', but does not affect polarized drop b', designating the group of trunks B^2, as the subscriber will have sent over the line a current capable of operating the drop b, but to which the drop b' is inoperative. The exchange operator then knows that a subscriber in the A-board class is wanted and inserts a plug A^3, belonging to a trunk of the group A^2, into the jack of the called subscriber, thereby opening the signal circuit to the drops and opening busy-test circuit to put the busy test on the line. Removal of the plug A^4 from its socket will have caused the spring i to break connection with the contact k and to close against the contact j, thus causing current to flow from the battery main T^2 on signal wire W thru the signal S, over spring i and contact k', and thru the pilot relay m to the battery main T'. The operator at A^3 seeing the pilot signal m' displayed, which is a general signal for all the cords in that position, and is controlled by the relay m, knows that some cord is to be connected with some line, and the signal S, being associated only with the plug A^3, designates that it is that plug on which a connection is wanted. Thereupon the corresponding listening key F F is operated and the operator inquires of the subscriber the number wanted, and when this has been ascertained, the operator touches the test piece o of the jack of the number wanted with the tip of the plug A^3.

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Should the result be that the line called for is found to be busy at one of the upper jacks on the board A, the ring contacts o' of that jack will be open and current will flow from the tip of the plug A^3 to the test piece o of the jack under test in the middle position on the board to the battery X and lower half of the test coil w^5 thru branch w^4, wire w, and contact F of the testing key back to the tip of plug A^3. Should the line called for be busy at one of the lower horizontal series of jacks on the calling board A, the contacts o' of that jack will be open and current will flow from the tip of plug A^3 to the test piece o of the jack under test in the middle position on the board, thru the contacts o' of the last-named jack, thru the contacts o' of the upper jacks, battery Y, and upper half of the test coil w^5, and over branch w^4, wire w, and contacts of the listening key F F back to the tip of plug A^3. Thus in either case the secondary w^3 will have been inductively affected by the energized section of the test coil w^5 and a click produced in the operator's receiver, notifying the operator that the line asked for or under test is busy. Should the line asked for not be in use, current will flow from the batteries X and Y to the test piece o of the jack under test, thence to the tip of the plug A^3, with which the test piece is touched, thru one side of the listening key F F to the center of the test coil w^5, over which it divides equally and differentially around the core of the coil to the resistances R R', employed to adjust the balance, and to the opposite poles of the batteries X and Y. As the current will have passed equally and differentially around the core of the operator's coil, no effect is produced upon the secondary w^3 thereof, and the line tested will be found to be not busy, so that the plug may be inserted. When a sleeve h and a test piece o are brought into contact by the insertion of a plug into a jack, current flows from the battery main y thru signal g^5, contact g^4, controlled by the listening key g^2 g^3, (and which is kept closed by the operator, as the key is in listening position to enable it to be ascertained when the party called has answered), signal wire x, sleeve h and test piece o along the test circuit to the negative pole of the battery X. This causes the signal g^5 to be displayed and notifies the operator at A^4 that the connection has been completed, whereupon that operator rings with the key g g' to call the subscriber wanted. When conversation begins between the two subscribers thus connected, the operator at A^4 releases the listening key g^2 g^3, whereby the signal g^5 is restored. The operator at A^4 then supervises the call, and the operator at A^3 is relieved of all ringing, etc., as soon as the connection has been made.

The condensers r r', while of a capacity sufficient to transmit speech, effectually stop the greater part of the signaling current from the subscriber's station and force it thru the relay in that part of the line in which the current originated. Thus when either subscriber signals the operator to disconnect the line by operating the generator at the telephone with the hook up, the line coil of the clear-out relay p^2 or q^2 is energized. This causes the armature contacts to close and the respective auxiliary coil to be energized by current from the battery-main T' and wire W flowing thru the signal p' and q' and the respective signal to be displayed, and the relay is locked and the signal continuously displayed until the circuit is opened, as by separating the contacts p^3 q^3 or by replacement of the plugs A^4 A^3 and the consequent opening of the auxiliary-coil circuit to the battery main T^2 and contacts j and j'. Thus when either subscriber rings off, the operator knows which it was, and if it be the one who was called and no ring-off signal follows from the calling subscriber, the wish of the latter will be inquired; but should another connection be wanted, the operator may order it from the multiple operator of the class containing the subscriber ascertained as the result of the inquiry. If both subscribers ring off, the operator at A^4 removes the plug from the jack on the board A' and restores it to its socket, thereby causing the springs to break contact with the contact j and close against the contact k, and current to flow from battery main T over signal wire W, thru signal S, spring i, contact j, and relay l to battery

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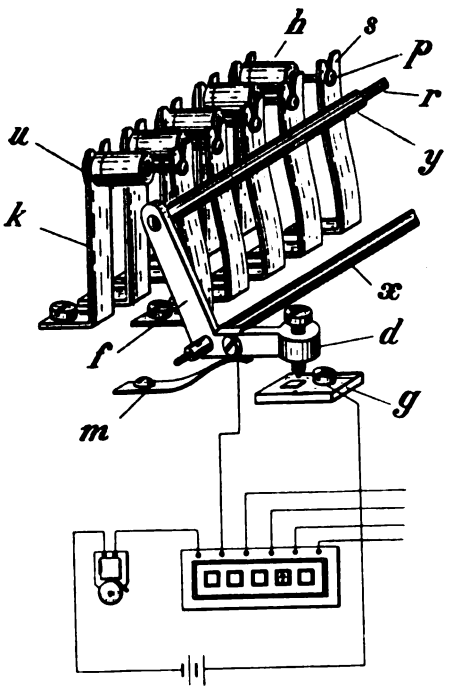
main T^2, and thus cause the general signal *l* to be displayed, notifying the operator at A^3 that some plug requires to be removed from a jack on the multiple board. The signal S designates the individual plug, which is then removed and replaced in its socket, thereby causing the spring *i* to break contact with the contact *j* and close against the contact *k*, thus giving to spring *i* the same potential as spring *i*, and as both springs are then in connection with the battery main T, current ceases to flow and the signals are restored.

JEAN PIEL, SCHOENBERG, NEAR BERLIN, GERMANY. PROTECTOR FOR TELEPHONE OR TELEGRAPH INSTRUMENTS. No. 674,541. MAY 21, 1901.

This device has been patented in Germany and is intended to be used with heat coils and fuse wire. While it is

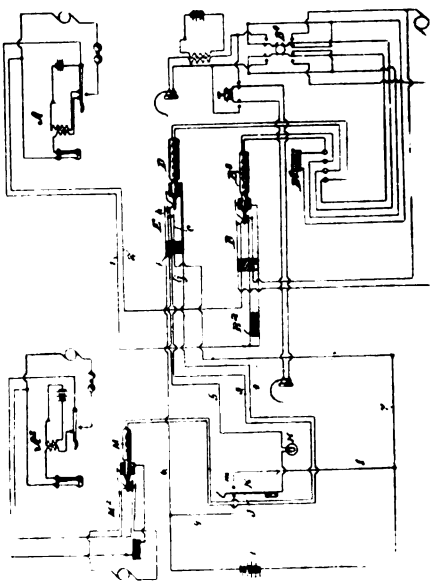


No. 674,541.

classed under the head of protecting devices, it does nothing in reality to protect. Its mission and operation is as follows: After the spring S is released by discharge of current, it flies back against the rod Y, which in turn forces an electrical contact between the points D and G, thereby closing the circuit, which gives the alarm either thru a bell or annunciator, or both. This is claimed to do away with the trouble of a visual inspection after a lightning storm, as each fifty are connected against one of these devices, which as soon as the circuit is open, immediately gives a signal.

HAROLD A. DOUGLAS, GRAND RAPIDS, MICHIGAN. TRUNKING SYSTEM. No. 674,402. MAY 21, 1901.

Illustration is a diagram of this system, which explains itself.



No. 674,402.

ELLIS F. FROST, WASHINGTON, D. C. TELEPHONE SWITCHBOARD. No. 674,862. MAY 28, 1901.

This is an effort to get away with the different annunciators from each subscriber. Reference to the illustration shows diagrammatically the line circuits, the common-return wire, the common-battery supply and the ringing current. Now, if the subscriber desires to signal the central office, by the aid of the switch hook he disconnects his line from the earth and connects it to the common-return line C. The circuit is now from the earth battery A, common-return line C, subscriber's telephone line 2, drop N and bus-bar E to earth. To answer this signal, the operator removes

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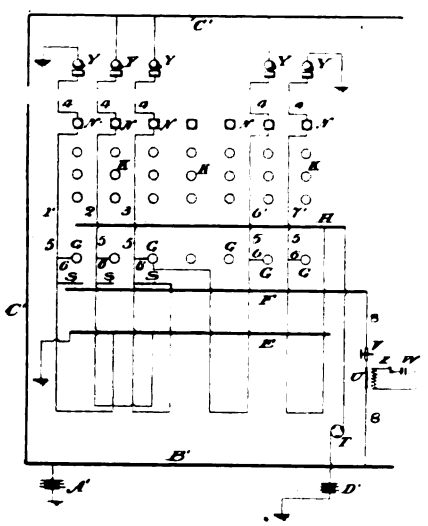
the plug R from the bus-bar E, connects it to the telephone bus-bar F, as shown in line 3. The subscriber has in the meantime, by appropriate mechanism, connected his line thru his telephoning apparatus to the common-return line C. If he desires to be connected with a subscriber, say, of line C, the operator first signals the subscriber of the desired line by removing the plug of the subscriber's line to be signaled over from the bus-bar E and connecting it to the bus-bar H. This connection of the line is shown in line 7, the current from the battery D thru the circuit-breaking T operating the subscriber's signal Y. The operator then removes the plug R from the bus-bar H, so that the signaling of the subscriber shall cease, and connects it with the socket G of line 3, the lines 3 and 6 being represented as being connected to-

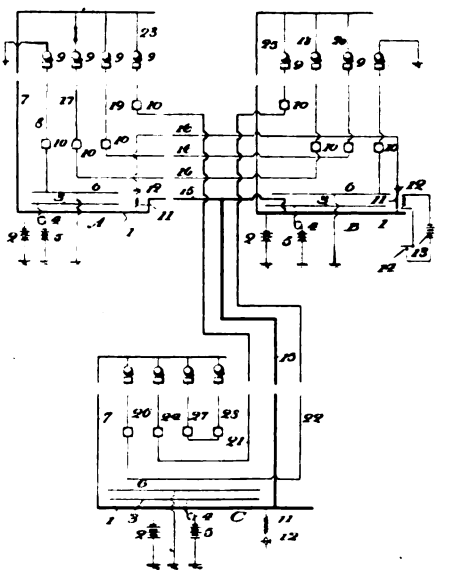


No. 674,862.

gether, the operator's telephone, line 8, being in shunt to the connected lines, as shown in Fig. 3, the operator's telephone line 8 being connected to the lines 3 and 6 by means of a plug connecting the bus-bar F with the spring S. When satisfied that the subscribers of lines 3 and 6 are conversing, the operator removes the plug of line 3 from the telephone bus-bar F and allows it to fall to rest in the hole Q in the table B of Fig. 2. Fig. 4 represents diagrammatically the wiring of two or more switchboards in order to enable a telephone line of one switchboard to be connected with that of another.

ELLIS F. FROST, WASHINGTON, D. C. TRUNKING LINE CIRCUIT. No. 674,860. MAY 28, 1901.

The telephone lines extend from the central office to the subscriber's station, and when not in use are connected to the central office to bus-bar 6 and at the subscriber's station to ground. The



No. 674,860.

common-return line 7 extends to each subscriber's station. The various common-return lines like 7 and 15 must for their successful employment be of relatively low resistance to that of the telephone lines. The object in having these various common-return lines of a relatively low resistance is to prevent the telephone currents of one telephone line finding their return path over other telephone lines. Therefore the object in making the common-return lines of relatively low resistance is to prevent any confusion in the telephone circuits due to what is known as "cross-talk."

CHARLES E. EAGAN, DURHAM, NORTH CAROLINA. TELEPHONE PAY STATION. No. 675,378. JUNE 4, 1901.

This is another refunding slot machine. Its method of operation is quite

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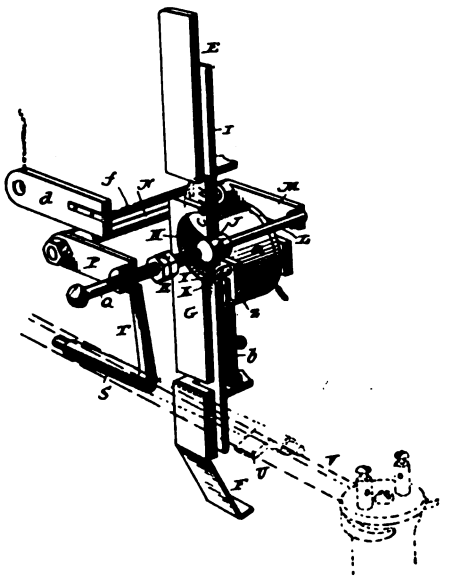
simple. A switch or contact-closer is placed in the main line under the operator. The generator circuit is open and is closed by the deposit of a coin. The coin, as will be seen, is held by the

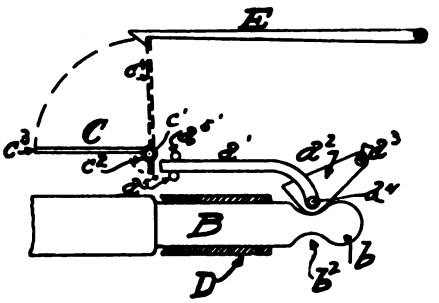


No. 675,378.

plunger or ejector *k*. After the generator has been operated and the central office called, the subscriber lifts the receiver from the hook. This permits the spring W to come into action, moving the frame and allowing the coin to drop down and rest upon the finger Y. If the desired party and connection is made, the main-line circuit is closed in the usual manner. After the conversation is terminated, the user hangs up the receiver, which causes the ejector *k* to knock the coin off the supporting member Y thru the opening H to the box. Should it happen, however, that the person can not be reached, the central office will so inform the user, at the same time closing the contact *j*, while the user operates the contact-closer H, thus energizing the magnet A, which causes the attraction of the armature I and withdraws Y from beneath the coin, allowing the coin to pass out on thru the receiver F. Another sheet of this patent shows this device in use on a three-coin slot machine, the operator having separate control over each separate slot.

HARRY C. DODGE, CLEVELAND, OHIO. SELF-RESTORING DROP. No. 675,377. JUNE 4, 1901.

In this patent, the system of toggle levers is applied. The lip in the plug

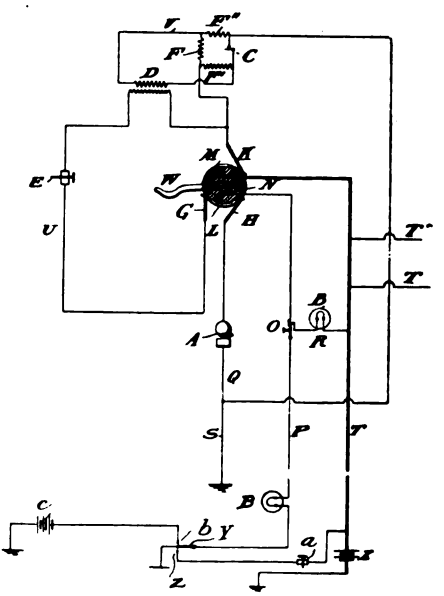


No. 675,377.

engages against a cam either upon entering or leaving the jack. This motion in turn is communicated to the shutter proper by the aid of a lever. This restores the shutter to its normal position.

ELLIS F. FROST, WASHINGTON, D. C. TELEPHONE CIRCUIT SYSTEM. No. 675,964. MAY 28, 1901.

This 'phone is intended to be used with the switchboard described in the



No. 675,964.

preceding patents. Illustration is a diagrammatic view of its connections.

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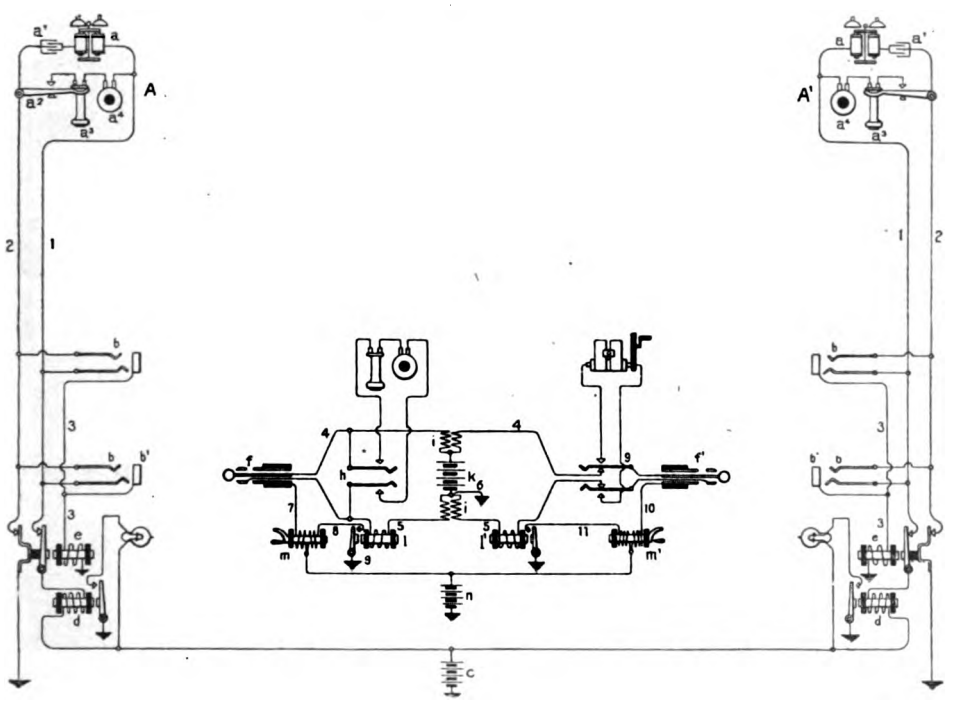
CHARLES E. SCRIBNER, CHICAGO, ILL. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS. No. 676,517. JUNE 18, 1901.

It is now common in the equipment of telephone exchanges to provide at each station means for normally interrupting the line circuit as to continuous current, with a switch for closing the line in the use of the telephone, together with relays connected with the lines in the switchboard, each responsive to current thus determined in one of the lines, together with the supervisor's signal, controlled by each relay. The supervisor's signal in practice has been interposed in the act of making connections. Incandescent lamps have been used as supervisory signals, in which case the controlling relay thereof has been arranged to shunt the lamp when the relay was excited, in order that the continuity of current thru the local circuit associated with the telephone line might be preserved; but this method of controlling the supervisory signal has been defective in that it greatly increased the potential applied to the portion of the local circuit associated with the line which commonly forms a part of the circuit. In this invention the use of the electromagnetic supervisory signals controlled by the relays, each signal having two windings differentially disposed, one of which is in a local circuit closed in making connection with a line, and the other of which is in a branch of the local circuit controlled by the supervisory relay, to be closed when the relay is excited. In this invention the magnet of the supervisory relay may be rendered inert thru the action of the controlling relay without alternating the electromotive force applied to the conductor associated with the line. The illustration shows this invention.



No. 676,517.

JOSEPH J. O'CONNELL, CHICAGO, ILLINOIS. CALLING APPARATUS FOR PARTY-TELEPHONE LINES. No. 674,515. MAY 21, 1901.

The diagram shows four party lines connected to an exchange. The grounded branches at station A and B are connected to one leg of the line, and stations C and D are connected to the other leg. Call bells E and E are adapted to

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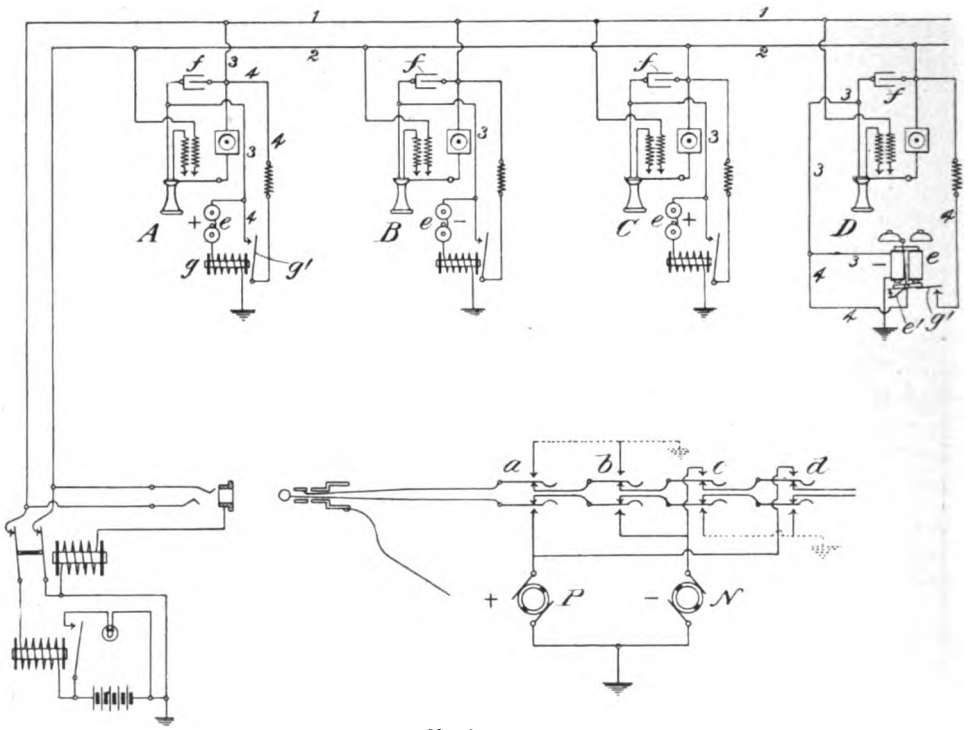
respond to pulsating current of characteristic sign. Thus, the two bells which are connected to the limb *l* A and B; the one at station A is adjusted so as to respond only to currents of a positive pulsation, and the one B to respond to the negative pulsation. The bells at C and D are connected to leg 2, but adjusted in a similar manner.

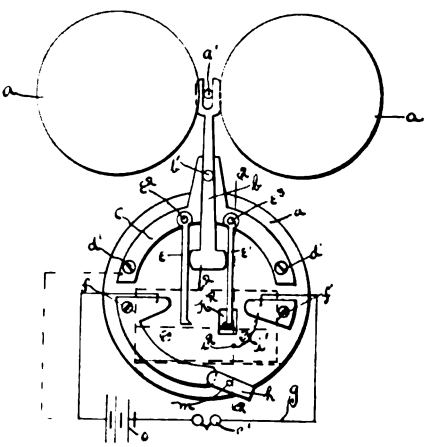


No. 674,515.

VANDIVER J. VAN HORN, KEOKUK, IOWA. EXTENSION BELL FOR TELEPHONES. No. 675,685. JUNE 4, 1901.

This is an extension-bell device which is fastened upon the door of the magneto, usually with the hammer or clapper thereof, a lever which is adapted to be rocked or oscillated to effect the closing of the extension circuit. The lever may operate when rocked to release a contact arm which will permanently close the extension circuit until manually opened, or the lever may serve to actuate parts which will temporarily close the extension circuit, opening the same again as soon as the main bell ceases to operate.

The hammer or clapper is adapted to vibrate in the usual manner between the gongs *a a* and is mounted to move with the armature a^2, which is oscillated by means of the magnets a^3 a^5.



No. 675,685.

adapted to be traversed by the ringing-current. A lever *b*, pivoted at *b'* to the plate or frame *c*, has a bifurcated end

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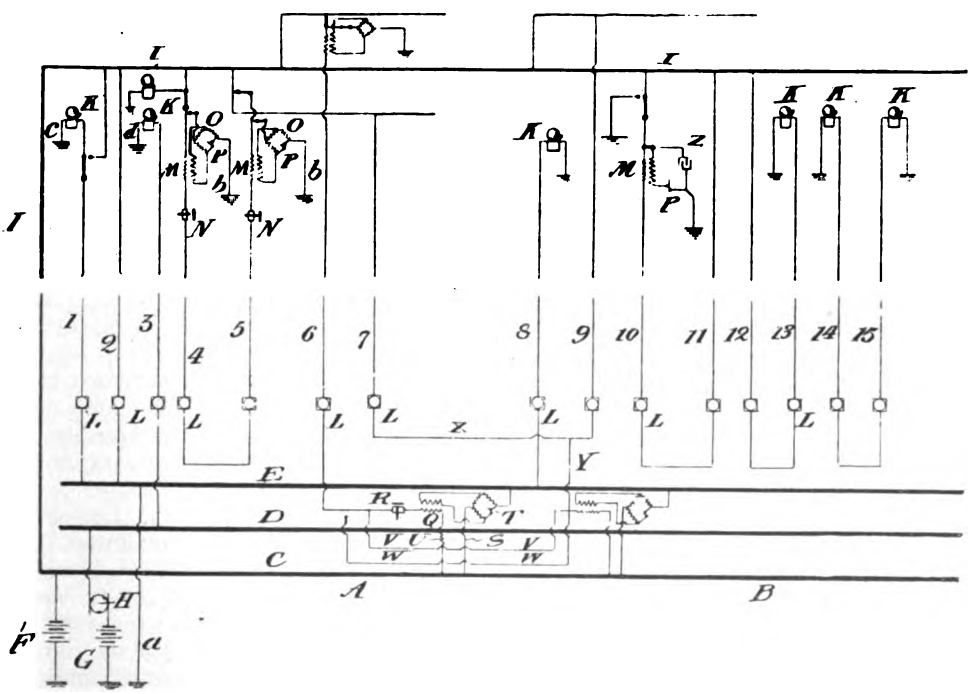
adapted to engage the hammer or clapper a' and carries at the opposite end an enlarged portion or hammer b^2, adapted to vibrate between the pendulum-rods e e', pivoted, respectively, at c^2 and c^3 to the plate c. Metal contact-strips f and f' are secured to the insulating-base d, and the battery o and the extension-bell g' are connected between the contact-plates f and f'. At the lower end of the base d is a switch h, mounted to rotate about a pin m, which extends thru the base. On the back of the base d is mounted the plate i, connected with the contact-plate f' by means of a wire i', passing thru the hole i^2 in the base d, and to the plate i is hinged the drop or shutter k, having a lateral arm k', adapted to extend thru the opening k^2 in the base d.

ELLIS F. FROST, WASHINGTON, D. C. TELEPHONE CIRCUIT SYSTEM. No. 674,861. May 28, 1901.

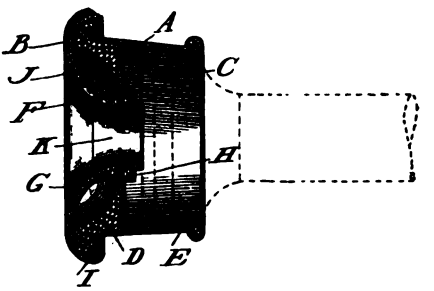
In this invention the source of energy pertaining to a switchboard is connected to a bus-bar. In the common return, together with the ground, are handled in the same manner. The illustration shows the method of connection.



No. 674,861.

HAHNEMANN ADOLPHUS CUTMORE, LEE, ENGLAND. RECEIVER ATTACHMENT. No. 675,467. JUNE 4, 1901.

This is a device intended to be fastened to the top of the receiver so that it



No. 675,467.

will fit more closely to the ear. The illustration is self-explanatory.

A metallic flared-mouth tube K is inserted in the throat of the neck F. This tube is held in rigid contact over the opening in the receiver to the diaphragm, so as to allow the sounds to pass direct from the receiver to the ear clear and distinct. The contrivance fitted upon a receiver in use is pressed firmly against the ear, thereby preventing the entrance of extraneous sounds.

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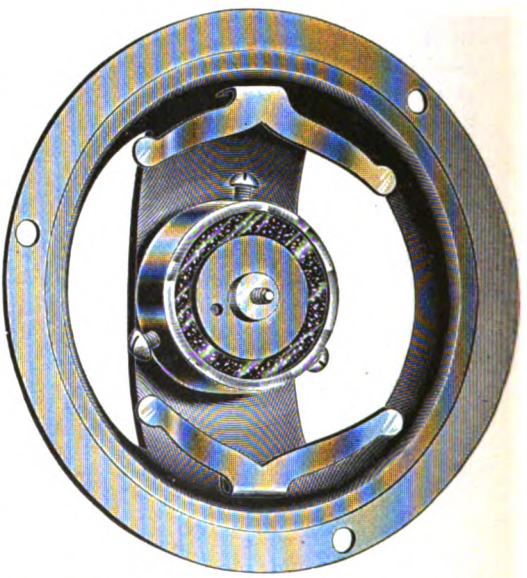
A NEW TRANSMITTER.

The telephone transmitter manufactured by the Swedish-American Telephone Company, of Chicago, and covered by patent No. 632,355, Tiodolf Lidberg, and dated September 5, 1899, assigned to the Swedish-American Telephone Company, and patent No. 667,-327, Tiodolf Lidberg, and dated February 5, 1901, assigned to the Swedish-American Telephone Company, are said to mark an epoch in the development of modern telephone construction. In these instruments the diaphragm is held under a state of stress by springs applied on either side of the center thereof, thus rendering the diaphragm highly sensitive to any vibration that may be impinged thereon and preventing any self-induced effect due to the operation of sluggish, inactive diaphragms not under stress. The result is that the instrument is highly sensitive to vibration, is delicately responsive, and, like a tuned instrument, its responses are harmonious with the producing cause. The tension is placed upon the diaphragm, so that the smallest vibration will at once set it into operation, whereas in diaphragms that are not under tension, the smaller vibrations are absorbed by the effect of producing a tension thereon, and the more powerful vibrations are only transmitted.

A second diaphragm is placed over the receptacle containing the finely divided resistance material, so that the said material is confined within the case permanently and substantially, and in a manner to prevent any undue resistance by the operation of the electrode therein.

The instruments are exceedingly simple in construction, highly efficient and belong to a class strictly new and original which are secured to the said company by the patents heretofore named.

Besides the advantages just described which inure to the benefit of the purchaser or the user, the instrument contains other advantages which are highly beneficial to the manufacturer, such as a means and method of construction and a means of adjustment after the instrument has been assembled, whereby the most positive and yet the most sensitive adjustment may be effected after the instrument has been placed in circuit. This instrument is the highest and most



advanced class, and is not simply a copy of patents that have expired. It embraces advantageous qualifications that are not to be found in instruments in which the diaphragm is not attuned to the service for which it is required.

When it comes to meeting requirements of severe and difficult conditions, the Swedish-American Telephone Company, of Chicago, always rises to the emergency and produces apparatus that preëminently meets the demands of any and all phases of telephony. Cut shows its new 150,000-ohm magneto bell, which is conceded the most powerful magneto ever built. Cut No. 60 shows a new departure lineman's test set. Inasmuch as same will generate either direct or alternating current, same can be attached to a party line with any

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number of telephones on same, and inspector can call up central office without disturbing any of the telephones. Set is neat and very compact.

This company is the first independent manufacturer to place on the market a transmitter that is absolutely superior to the American Bell long-distance. This transmitter costs more to construct than any other transmitter and is a perfect mechanical apparatus; no such crude methods as using corn plasters, felt or flannel rags go into its construction either for carbon retainer or adjustment. Has heavy metal diaphragm which is supported on four auxiliary springs, which keep same in a perfect state of uniform vibratory power. Front cap is a heavy brass casting, engine lathe turned. This company's receiver also is equipped with four auxiliary springs, which prevent the magnetic effect to buckle the diaphragm. This receiver has a double shell — outer one of rubber, inner one of metal, using same doubly strong, also prevents same from getting out of adjustment as same is made in the metal part only. Changes in temperature do not affect this receiver.

This company surely must make exceptionally good apparatus, as their business has actually increased one hundred per cent within the last four months. One year and a half ago they occupied about fifteen hundred square feet of floor space and employed five people. Now they occupy over twenty-five thousand square feet of floor space and employ nearly two hundred people. This company's motto is to manufacture nothing cheap, believing that the best is the cheapest. The TELEPHONE MAGAZINE predicts great success for this concern and in a short time this company will be the largest manufacturer of telephone apparatus in the United States.

The exhibit of the Utica Drop Forge & Tool Company and the Smith & Hemenway Company can be seen at the Pan-American Exposition, in Section S, Electricity building, Marland's Collective Exhibit. Printed matter and catalogs are being distributed at their booth.

Our readers in glancing over the advertising pages could not fail to notice the advertisement of Palm, Fechteler & Co., 45 La Salle street, Chicago, manufacturers of transfer ornaments. This may seem strange to many, so a few words of explanation. There is very rapid advancement in the telephone business, and the up-to-date manufacturer is now decorating his telephone switchboards, junction boxes and cable heads with transfer ornaments; in fact, this company, owing to the heavy demand for transfers to be used for this purpose, has been compelled to enlarge its lines of designs. This company makes special designs to order, and for quite some time has been furnishing several of the leading companies with name plates. There is nothing more attractive in a name plate than a transfer ornament. This company will be pleased to figure on special designs or name plates. It will also be pleased to send illustrations of its many stock designs.

A NEW TELEPHONE FUSE.

The American Electric Fuse Company, of New York, Chicago and San Francisco, has just perfected a new telephone fuse which it claims to be the best fuse on the market today. This fuse resembles in appearance the old style of fuse manufactured by the fuse company, but the fuse wire is enclosed between two pieces of mica, absolutely preventing any possibility of breakage. The fuse-wire is left loose in the middle of the fuse, so that it fuses more actually than does any other of the fuses ever manufactured of its kind.

The fuse wire, which is the only delicate part of the fuse, is enclosed entirely and protected against any possibility of damage. The fuses are furnished in any amperage desired for telephone work, either in Western Union or Postal style, at ¾ cent each, fifty or one hundred being packed in a box, which is carefully labeled and packed.

Tests with a box of these fuses have been made after tossing the box about and playing ball with it for fifteen minutes, and every fuse was found to be

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perfect and uninjured, despite the rough handling it had received. The fuses may be stamped on, stepped on, pushed roughly into place, or handled in almost any manner without the slightest injury. They may be bent almost into the form of a bow and will go back to their proper place without any damage.

The company has made a large number of tests in order to secure the perfection of this device and takes great pleasure in announcing that samples of these fuses are now ready for the market. No fiber or other like substance is used in any way in connection with these fuses. They are absolutely moisture proof, indestructible, and will last a lifetime, unless burned out.

Old fuses can be repaired at a nominal cost.

There is nothing about the fuse that can possibly get out of order, all the parts are fastened in place and arcs or sparks are prevented by the perfect insulation of the fuse.

Samples will be sent free to any inquirers.

This fuse will fit any standard block on the market, and can be furnished in any special shape or design required.

ERICSSON TELEPHONE COMPANY.

We have been informed by the Ericsson Telephone Company, 296 Broadway, New York city, that the Ericsson telephone was awarded first prize at Paris, 1881; Madrid, 1883; Vienna, 1884; Stockholm, 1886; Copenhagen, 1888; Chicago, 1893. Also that its exhibit in Paris in 1900 was from the St. Petersburg, Russia, factory, and was awarded first prize. This year its exhibit of a fifty-subscriber switchboard and a few of its different telephones at the Pan-American Exposition at Buffalo is made in Section S of the Electricity building, and Mr. W. Jac Marland will have charge of the exhibit.

Thru us it extends to all its friends and patrons a cordial invitation to see its exhibit and talk over its instruments. It is exhibiting its goods in connection with others in a collective electrical exhibit, which will doubtless prove of interest to many of our readers.

THE Griggs Manufacturing Company, of Chicago, is now placing on the market a new device in the form of a telephone desk bracket. It is not only a convenience, but a necessity to the telephone user, as it is easily attached to the desk and is always in place when wanted, and pushed out of the way when not needed. It is constructed from the best steel, with highly polished nickel, thus adding to the appearance of your desk. It is also a durable attachment, which can not be broken or get out of order. Another good feature is that everybodv having a curtain desk will readily see the merit of this bracket, as with it it is not necessary to tip or lift the 'phone off your desk when you want to close it, thus saving time and labor.

O. W. SMITH, producer and dealer in cedar poles, will be pleased to furnish quotations on cedar poles of any dimension. This gentleman has yards thruout the cedar-pole country, and is therefore able to make prompt shipments. Parties contemplating building either toll or exchange lines would do well to secure quotations from this gentleman.

THE Western Electric Instrument Company has removed from its former location, at 214 William street, Newark, New Jersey, to Waverly Park, Essex county, New Jersey.

WE are in receipt of a catalog from the Durham Telephone Manufacturing Company, of Durham, North Carolina, U. S. A. This catalog contains some new devices and a complete line of telephone apparatus. The instruments illustrated in this catalog appear to be of the highest character. This company has a number of catalogs and price-lists which are waiting parties interested in telephony.

THE Electric Appliance Company, Chicago, is putting out a high-grade bridging telephone, which is especially recommended for farmers' line work, where a low-priced, but first-class instrument is desired. Catalog will be sent upon application.

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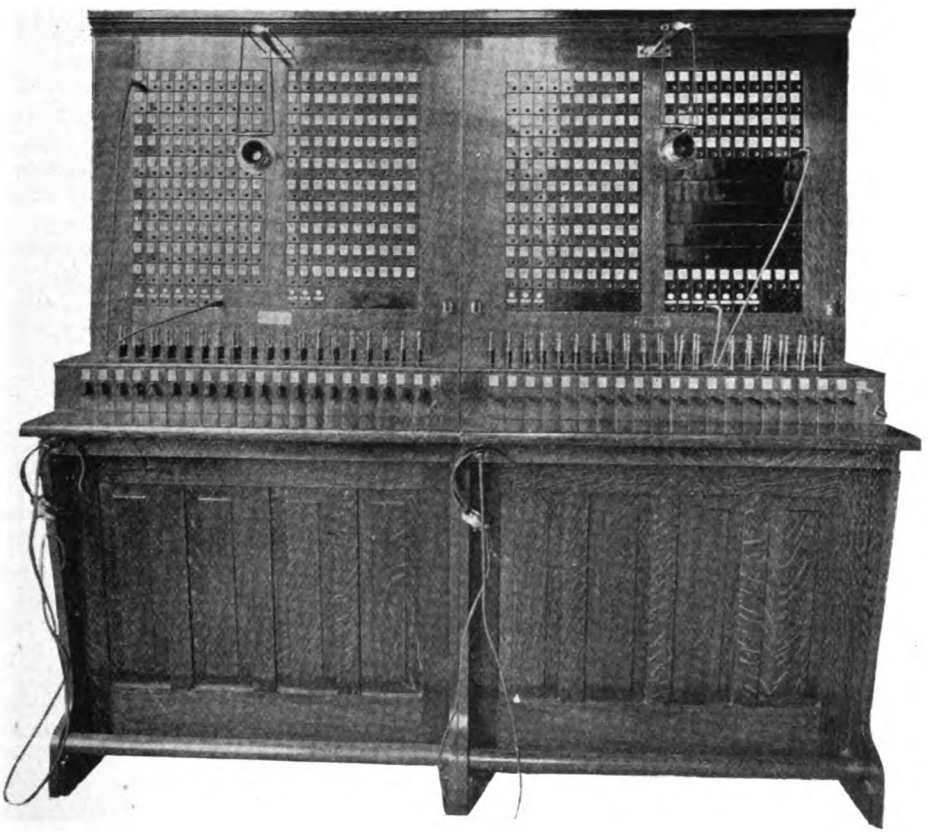
THE EUREKA METALLIC EXPRESS SWITCHBOARD.

The accompanying illustration represents a section of the switchboard manufactured by the Eureka Electric Company, of Chicago. This board is of the pattern known as the Eureka Metallic Express, having a capacity in the flashlight trunking section of the board of 600 drops, and capacity for regular drops, both tubular and series,



of 400, with 350 drops installed, excluding the flashlight transfers.

The drops themselves are self-contained and removable, and these same features distinguish the clear-outs, which are constructed in the removable self-contained Eureka Express cam.

The transfers are also removable, and it is the claim of the company that there is no board on the market possessing these valuable features to the extent as does the Eureka Metallic Express.

The operation of the transfers is one of the simplest, the insertion of the plug in one section operates to light its lamp on both that section and the section called. The called operator inserting her plug puts out both lights. When thru talking, either operator withdrawing signals to the opposite board to also withdraw her plug, for the reason that a transfer with a plug in the board will signal both sides by a flashlight, thereby avoiding any possibility of hanging up a subscriber or a pair of cords.

The Eureka Electric Company will be pleased to give additional information concerning its high-grade apparatus. It is the claim of the company that it has installed close on to eighteen hundred switchboards within three years, and it has never for any cause had a board displaced.

The company is at work at the present time on its new multiple, which will

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possess special features, as well as its new flashlight.

In the next issue will be shown a cut of the new flashlight board, which possesses more special features than any switchboard ever placed on the market, and if the success of the Eureka Metallic Express switchboard is any criterion, its flashlight will certainly have an extremely large sale.

The company will be pleased to give additional information concerning any of its high-grade products, of which it manufactures one of the largest lines in this country.

The Eureka Electric Company, of Chicago, is now distributing what is known as its special Telephone Supply Construction Material Catalog. This catalog is one of the most complete ever put out by any concern in the independent field. The company will also be pleased to send to telephone purchasers its regular telephone catalog, which is one of the largest issued, embracing its large line of guaranteed apparatus.

The Eureka Electric Company would also be pleased to send to any person or company interested, in the independent field, one of its No. 1 special transmitters made up in a beautiful little design for a watch charm, with its compliments.

THE POSTOFFICE TELEPHONES.

Some interesting information relating to the new postal telephone system was elicited from the Secretary of the Treasury, as representing the Postmaster-General, in the House of Commons on Tuesday. In reply to Sir James Woodhouse, Mr. Austen Chamberlain said the expenditure already authorized by the Treasury under the provision of the telegraph act, 1899, for works in progress or about to be undertaken, amounts to £813,040. Of this amount £677,945 is for the London exchange system and £135,095 for the development of the other parts of the Postoffice telephone system in various places, but more particularly in the northeast of England and in South Wales. The actual payments for new works brought to account up to March 31 last amount to £269,941. Mr. Chamberlain went on to say that it is not possible at this stage to state definitely what the final cost of the London exchange system will be, but the whole sum of £2,000,000 authorized by Parliament will be expended in such extensions of the Postoffice telephone system as seem most urgently necessary, whether in London or elsewhere. The delay in opening the most important exchanges of the London system has been due to the scarcity of skilled labor, the difficulty of getting materials for contractors, the necessary restrictions on the opening of streets to avoid excessive interference with traffic, and the difficulty of constructing exchanges in buildings in use for other Postoffice work. Full particulars of the rates and conditions of the service will be brought before the public at an early date, and it is hoped that it will be available in some parts of London in the autumn.

WIRE INSULATION.

The use of animal intestines in the insulation of conductors is the subject of a patent granted July 2 to C. E. Woods. The inventor has found that the intestines of many animals, especially of the sheep and hog, form very perfect insulating material when properly prepared and applied. The intestines are thoroly cleansed and purified, the inner and outer walls being preferred for the purposes of the invention. The intestine, preferably with its natural moisture still in it, is wrapped around the conductor so that the edges overlap. This forms a continuous sheath, for when so lapped the two overlying edges of the intestines become firmly united together. The intestines so applied speedily shrink and form a very close, firm and continuous sheet of coating for the conductor. This coating may be overlaid with a cotton or silk wrapping, shellac or coloring matter, or a coating of vulcanite, or it may be protected with silk braid to prevent it from mechanical injury in the winding of ammeters. This, of course, is not necessary.

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TELEPHONE NEWS.

CALIFORNIA.

SAN FRANCISCO, CAL.—M. Adrian King has filed a petition with the Board of Supervisors in which permission is asked to establish a telephone system. Fifty free telephones are offered to the city, a fire and police telegraph system at a cost not to exceed $12 for each telephone per year, and the agreement is offered that the company will forfeit all rights if it does not have five thousand subscribers at the end of three years.

CONNECTICUT.

NEW BRITAIN, CONN.—The stock of the Farmington Valley Telephone Company has increased its capital stock from $3,500 to $7,000.

DELAWARE.

DOVER, DEL.—An application was received from the Berks County Telephone Company asking for a dissolution of its charter recently secured here. It is believed that the telephone combine thruout Pennsylvania has absorbed the lines of the Berks Company.

FLORIDA.

CLEARWATER, FLA.—The Peninsular Telephone Company has received a franchise for a local system at Clearwater.

INVERNESS, FLA.—Florida Telegraph & Telephone Company; capital stock, $250,000.

ILLINOIS.

ATLANTA, ILL.—The Atlanta telephone exchange was sold by Dr. C. O. Burke to the Palmer-Darnell Company, of McLean, which will incorporate it with its extensive systems.

CHICAGO, ILL.—President Sabin, in pursuit of his policy to get more business for the suburban lines of the Chicago Telephone Company, has reduced the cost of 'phones from fifteen to twenty-five per cent, to take effect July 1.

CHICAGO, ILL.—The plant of the Stromberg-Carlson Telephone Manufacturing Company, at the southwest corner of Jackson boulevard and Clinton street, is to be enlarged by two additional stories. The work, for which Irving W. Kelley has made the plans, will cost $30,000.

CHILLICOTHE, ILL.—A resolution recently adopted by the Chillicothe city council granting T. Van Antwerp the right to construct a telephone system, was placed on record in the recorder's office. The provisions of the resolution are that a system can be constructed, the poles to be placed in alleys where possible, and that the franchise extends for fifteen years.

COLCHESTER, ILL.—Mr. Willard I. Savidge has been granted a franchise to build an independent telephone exchange in the city of Colchester. About fifty subscribers will be secured to start.

CLINTON, ILL.—The Farmers' Telephone Company has entered Clinton with lines from Tabor, Midland City and Kenney, and will at once deliver the Birkbeck, De Witt and Weldon lines to the exchange.

DALLAS CITY, ILL.—Dr. Bortz has twelve miles of poles up for his telephone line. He will have connection with Capt. E. H. Rand's lines, connecting with Dallas, Pontoosuc and Niota, and will also connect with lines running south.

DUNDEE, ILL.—There will be nothing but metallic long-distance wires henceforth installed in Dundee. The charges for these will be $60, $48, $42 and $36 per year. Residence 'phones will now be charged for as follows per month: ten-party line, $1; four-party line, $1.50; two-party line, $2; single line, $3. Business 'phones will cost per month: Ten-party line, $1.50; four-party line, $2; two-party line, $3; single line, $4.

ELIZABETH, ILL.—Jo Daviess County Mutual Telephone Company is incorporated with a capital stock of $2,500. The incorporators are William Skine, Ernest Stadel and Rudolph Dittmere.

ELGIN, ILL.—The Chicago Bell Telephone Company has just reduced the toll rate between Elgin and Carpentersville from 20 to 10 cents and between Dundee and Carpentersville from 10 to 5 cents. The independent telephone company forced the cut.

FRANKFORT, ILL.—The Northwestern Telephone Company is on the way here with a force now at Mokena, and arrangements have been made for installing the exchange here.

GIBSON CITY, ILL.—Gibson Telephone Company was incorporated with a capital stock of $12,000 to operate a telephone system. The incorporators are G. F. Schlosser, A. L. Phillips, H. A. Ball.

HOUSTON, ILL.—Farmers' Progressive Telephone Exchange: Capital, $190. Incorporators, A. M. Relpath, Thomas Brown, W. R. Preston.

HOMER, ILL.—The Northwestern Telephone Company has commenced work on the line from Homer to Marley.

LITTERBERRY, ILL.—Liter-Arcadia Telephone Company has increased its capital stock from $1,500 to $5,500.

MOUNT PULASKI, ILL.—The Telephone extension erected this spring between Mount Pulaski and Decatur has been completed.

MOUNT VERNON, ILL.—The Farmers' Tri-county Telephone Exchange has completed its line here. The capital stock has recently increased to $1,500.

MONMOUTH, ILL.—The Monmouth Telephone Company, located at Monmouth, certi-

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fies to an increase in capital stock from $35,000 to $50,000.

MASCOUTAH, ILL.—The Kinloch Telephone Company is trying to get a franchise to run into Mascoutah. The company proposes to put up 'phones in business and private houses at a rate of $1 a month. The rate to other cities is to be much cheaper than the Bell Company at present charges.

OGDEN, ILL.—The Farmers' Mutual Telephone Company at Ogden will connect their line with the Fithian exchange.

OTTAWA, ILL.—A franchise has been granted the Northern Illinois Telephone Company to erect an exchange here.

PEKIN, ILL.— Citizens' Telephone Company. The capital stock is $50,000. To operate a telephone system. The incorporators are J. M. James, J. W. Barrett, E. R. Peyton.

PEKIN, ILL.—The Tazewell County Telephone Company has increased its capital stock from $2,500 to $10,000.

POLO, ILL.—The Ogle County Telephone Company is rushing its work in Polo, hoping to have the new system installed by July 1. It will have all the county lines of the Rochelle Company west of Oregon.

ROCKFORD, ILL.—The Bills-Wortham Company was granted a franchise to build a telephone exchange here.

WEST CHICAGO, ILL.—The Chicago Telephone Company has reduced its rates between this city and Naperville from 20 to 10 cents.

WENONA, ILL.—The Wenona Telephone exchange is incorporated with a capital stock of $2,500.

INDIANA.

BRAZIL, IND.—The Citizens' Telephone Company, of Brazil. Capital stock, $10,000. Directors, Theodore W. Englehart, H. D. Talk, M. J. Murphy, C. J. McCullough, Oscar Houk and John G. H. Klingler.

CLINTON, IND.—The Farmers' Mutual Telephone Company, of Clinton township, has been incorporated with $5,000 capital, and will endeavor to extend its lines all over the county. It is already serving one hundred rural subscribers in Clinton township.

COLUMBUS, IND.—The Citizens' Telephone Company has reëlected its old officers and has increased its capital stock from $15,000 to $30,000.

ELKHART, IND.—The Farmers' Mutual Telephone Company, of Elkhart. Capital stock, $5,000. Directors, J. J. Zollinger, R. W. Davenport, C. R. Myers, J. R. Cripe, Harvey Myers and A. J. Yades.

SALEM, IND.—The Hoosier Telephone Company, of Salem, was granted a franchise for the erection of a modern telephone exchange.

TERRE HAUTE, IND.—The Citizens' Telephone Company let contracts for supplies worth about $18,000. The company has ordered 18,000 feet of 120 pr cable, 300 poles and 100 miles of telephone wire.

IOWA.

BURLINGTON, IOWA.—The Winfield Telephone Company is about to increase its capital stock from $3,500 to $10,000 for the purpose of extending its lines to connect with Burlington and intermediate points.

CEDAR RAPIDS, IOWA.— National Telephone Company; headquarters, Cedar Rapids. Capital stock, $15,000. W. H. Durin, N. M. Hubbard and others, incorporators.

DES MOINES, IOWA.—Trans-Mississippi Telephone & Telegraph Company was incorporated with a capital stock of $1,000,000. The directors are A. Harris, C. R. Huntley, T. E. Murray and others. Indebtedness is limited to $5,000,000. This company is a consolidation of the Citizens' General Electric Company and the People's Electric Light Company.

DES MOINES, IOWA.—The Northern Iowa Telephone Company has increased its capital stock to $40,000.

EAGLE GROVE, IOWA.—The farmers west of town are organizing a rural telephone company. They will erect their own line and connect with the telephone company in Eagle Grove. The expense for one hundred 'phones will be light and it looks as tho things would surely go thru.

EDDYVILLE, IOWA.—The Home Telephone has transferred its local headquarters here to the city exchange, known as the Eddyville Exchange, which has about eighty 'phones, and will soon reach one hundred, and is doing a good business.

FORT DODGE, IOWA.—The Fort Dodge Telephone Company has increased its capital stock double.

GRINNELL, IOWA.—The Home Telephone Company has been organized here with a capital stock of $25,000.

GOOSE LAKE, IOWA.—A telephone company has been organized at Goose Lake, Iowa. H. L. Boscom, president. This company expects to install about twenty-five miles of line and twenty-five or thirty telephones.

GARNAVILLO, IOWA.—The Garnavillo Telephone Company has filed articles of incorporation, with $10,000 capital stock, with the secretary of state. Its incorporators are A. A. Schmidt, J. F. Schumaker, Joseph Uriell, R. O. Schumacker.

HOPKINTON, IOWA.—The Hopkinton Telephone Company has filed articles of incorporation with the secretary of state. Its capital is $3,000. S. C. Carter and others are the incorporators.

KEOKUK, IOWA.—The Mississippi Valley Telephone Company, of Keokuk, filed amended articles of incorporation, increasing the capital stock from $100,000 to $200,000.

LITTLEPORT, IOWA.—The Standard Telephone Company has bought the Gruenwaldt telephone line.

MARENGO, IOWA.—The Marengo Telephone Exchange filed articles. The capital stock is $7,500. J. H. Branch is president; Henry Gode, vice-president; H. N. Havner, secretary; John Keil, Jr., treasurer.

MAXWELL, IOWA.—The Maxwell Telephone Company has filed articles of incorporation.

MOUNT HAMIL, IOWA.— German-American Telephone Company, of Mount Hamil. W. T.

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Wright and others, incorporators. The capital stock is $1,600.

PITTSFIELD, IOWA.—The Pike County Telephone Company has commenced the work of constructing a line from Pittsfield to Hull via El Lara, Barry and Kinderhook, which, it is expected, will ultimately be extended to Hannibal.

TABOR, IOWA.—The City Telephone Company has elected the following directors: W. Y. Gregory, W. H. Wyant, W. J. Bell, John Barbour, Al Wilkins, all of Tabor; Fred Anthony, S. T. Rhode, J. M. Coons, of Macedonia.

VOLGA CITY, IOWA.—The Standard Telephone Company will, as soon as possible, construct a telephone line from Elkport to Littleport, Mederville and Volga City.

KANSAS.

EMPORIA, KAN.—The Emporia Telephone Company is incorporated with $60,000 capital stock.

RILEY, KAN.—The telephone people are working on a line from Bala to Riley, and it will soon be completed.

TOPEKA, KAN.—The Wilson County Telephone Company has been incorporated, $750 capital stock.

KENTUCKY.

HAWESVILLE, KY.—The Hancock County Telephone Company. The capital stock is $3,000.

JEFFERSONVILLE, KY.—The Home Telephone Company is arranging to extend its service from Sellersburg to Charlestown. In time it will cover other points in Clark county. The new telephone company of Louisville is preparing to invade Jeffersonville.

LOUISIANA.

NEW IBERIA, LA.—The Louisiana & Texas Long Distance Telephone Company, Limited, has been incorporated at New Iberia, with R. F. Hogsett and Congressman R. F. Broussard as the leading stockholders.

MASSACHUSETTS.

LYNN, MASS.—The 'People's Telephone Company was recently granted a franchise to operate a telephone exchange in Lynn, and filed its bonds for $10,000 with the city clerk. This bond is to insure the carrying out of the agreement with the city.

MICHIGAN.

DETROIT, MICH.—The People's Telephone Company has fiied articles of association in Detroit. The stockholders of the company, with the number of shares held by each, are as follows: Arthur Pack, 400; Henry A. Everett, 8,750; J. C. Hutchins, 10; E. W. Moore, 8,750; John B. Sarliss, 10; Alex McPherson, 50; Henry Stephens, 50; Theo D. Buhl, 100; Joseph W. Martin, 250; Charles L. Palms, 10.

JACKSON, MICH.—The new People's Telephone Company contemplates spending about $1,000,000 in rebuilding the exchange at Jackson. The latest appliances will be put in and underground conduits will carry the wires.

EASTON, MICH.—The Easton Independent Telephone Company is building a telephone line thru Easton and Orleans, Ionia county. W. A. Strong is manager.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company, of Grand Rapids, Mich., has increased its capital stock from $550,000 to $1,000,000.

MENOMINEE, MICH.—Lindsley Brothers, of Menominee, have just made a deal for the sale of ten thousand telegraph poles to the American Telegraph & Telephone Company, of New York city.

ORION, MICH.—The Orion Telephone Company, with $5,000 capital, has just been organized in that village. The company has a village franchise and a local exchange with thirty subscribers which it acquired from the old private exchange. It also has a contract for state service over the Michigan lines and proposes to build farmer lines.

MINNESOTA.

CHELSEA, MINN.—The following corporations filed notice of increase of capital stock: Chelsea Telephone Company, Chelsea, from $10,000 to $20,000.

FULDA, MINN.—The Fulda Telephone Company has been incorporated with $25,000 capital stock.

MILLVILLE, MINN.—The Millville Telephone Company; $3,000 capital stock.

MINNEAPOLIS, MINN.—The Iron Range Electric Company increased its capital stock from $50,000 to $75,000.

VERONA, WIS.—A rural telephone line has been completed connecting Mount Horeb and Verona.

MONTANA.

BUTTE, MONT.—The Western Electric Telephone Company has asked for a franchise for a local system and intends to install an exchange amounting to $200,000.

HELENA, MONT.—The Lewiston Telephone Company filed notice with the secretary of state of the increase of capital stock from $10,000 to $25,000.

MISSOURI.

CRAIG, MO.—Incorporated: The Craig Telephone Company; the capital is $1,000; by F. K. Allen, E. J. Kellogg, W. S. Thompson and others.

JAMESON, MO.—Jameson Telephone Company has been incorporated for $3,500. The incorporators are A. J. Fuller and others.

MAYSVILLE, MO.—DeKalb County Mutual Telephone Company, of Maysville; capital stock, $5,000. Incorporated by J. E. Roberts, Eugene De Hart, James B. Mays and others.

MACON, MO.—Articles of incorporation of the Union Telephone Company have been filed. The directorate is composed of Joseph Miles, Charles T. Snow and James M. Landree. The capitalization is for $1,000, $860 of

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which has been paid in. The one hundred $10 shares are owned as follows: J. D. Miles, Atlanta, 32; L. M. Thompson, Atlanta, 2; John T. Farmer, Atlanta, 2; Charles T. Snow, Economy, 32; James M. Landree, Economy, 32. The office will be at Economy.

VERMONT, Mo.—The Tazewell County Telephone Company, located at Vermont, certifies to an increase in capital stock from $2,500 to $10,000.

WARRENSBURG, Mo.—Warrensburg and the Bell Telephone Company are having a heated scrap over the reduction of rates. The citizens show a determination to fight it out if it takes all summer.

NEBRASKA.

ALBION, NEB.—Articles of incorporation of the Albion Telephone Company, of Albion, Boone county, were recorded in the secretary of state's office. The company was capitalized for $20,000 and incorporated by A. Harris, president, and T. F. Martin, secretary.

COOK, NEB.—Articles of incorporation of the Home Telephone Company have been filed with the secretary of state. The company is capitalized for $30,000.

STOCKVILLE, NEB.—The Frontier County Telephone Company. The object of the company is to run a line from Stockville to Curtis. Capital stock, $2,000. Incorporators: A. J. Clifton, E. S. Case, M. T. Ward, J. H. Boyston, D. C. Dye, Eugene Hink, Charles Riggs.

TALMAGE, NEB.—The Nebraska City Telephone company has secured enough subscribers at Talmage to justify it putting in a switchboard and employing an operator.

NEW JERSEY.

JERSEY CITY, N. J.—Antiseptic Telephone Appliance Company. Capital stock $500,000. Object, manufacturing.

JERSEY CITY, N. J.—The Hudson-Middlesex Telephone & Telegraph Company; capital stock, $15,000.

NEWARK, N. J.—Essex Electric Company; capital stock, $700,000. The incorporators are: W. C. Clark, Simm Scheuer, R. H. McCarter and others.

NEW YORK.

ELMIRA, N. Y.—The Elmira Telephone Company, of Elmira, filed a certificate of increase of capital from $40,000 to $100,000.

ELMIRA, N. Y.—The Century Telephone Construction Company recently secured a franchise in Elmira.

HANCOCK, N. Y.—Hancock Telephone Company, of Hancock; capital stock, $3.000. Directors, E. J. Cotler, C. L. Wheeler and S. N. Wheeler, of Hancock.

JAMESTOWN, N. Y.—The common council voted unanimously to grant a franchise to the Home Telephone Company. The company agrees to commence operations before December 1, 1901, and to have its telephones in operation before October 1, 1902. It also agrees to furnish an unlimited local service, with long-distance instrument, for $30 a year. When the company has one thousand telephones in operation it agrees to pay one per centum of the gross earnings to the city, and to double this when two thousand are in use. Telephones for the use of the city are to be furnished free. A $3,000 check has been posted as a forfeit if the provisions are not complied with.

NEW YORK, N. Y.—Stockholders of the American Telegraph & Telephone Company held a special meeting here to increase the capital stock from $100,000,000 to $150,000,000.

SOUTH EDMESTON, N. Y.—The Wharton Valley Telephone Company; capital stock, $3,000. Directors, B. F. Bishop Garrattsville; Van Ness D. Robinson, Edmeston; Frank Harrington, West Burlington.

TROY, N. Y.—The Northern New York Telephone Company has sold its interests in the Hudson River Company. The consideration is said to be $100,000. The exchanges are Plattsburgh, Rouse's Point, Chateaugay, Malone, Keeseville, Ausable Forks, Keene, Lake Placid, Elizabethtown, Westport, Port Henry and Ticonderoga.

NORTH CAROLINA.

DURHAM, N. C.—The Interstate Telephone & Telegraph Company; principal office in Durham, N. C.; will install a new switchboard of twelve hundred drops capacity.

MURPHY, N. C.—The Cherokee Telephone Company, of Murphy, has been granted articles of incorporation with $2,500 capital stock.

OHIO.

AMESVILLE, OHIO.—The Amesville Telephone Company now has a line connected up with Broadwell and Utley.

BRADFORD, OHIO.—The Piqua Telephone Company joined their line to the Greenville company just outside the corporation. They do not enter the town at all.

BRYAN, OHIO.—The Bryan Telephone Company has increased its capital stock from $20,000 to $40,000.

CARDINGTON, OHIO.—The Morrow County Telephone Company, of Cardington, has increased its capital stock from $12,000 to $30,000. C. A. Whitney is the president and Harry B. McMillin secretary.

COLLINWOOD, OHIO.—The Collinwood Home Telephone Company has increased its capital stock from $25,000 to $50,000.

COLUMBUS, OHIO.—The Harrison County Telephone Company has increased its stock from $25,000 to $50,000.

FAIRVIEW, OHIO.—The Union Telephone Company has been incorporated with a capital stock of $10,000.

JERSEYVILLE, OHIO.—The Jerseyville Telephone Company has been incorporated with a capital stock of $3,000. The incorporators are F. A. Copeland, W. O. Copeland, E. C. Hecox, J. D. Morse and W. H. Tremaine.

PIQUA, OHIO.—The Piqua Home Telephone Company, Piqua, has filed notice of an

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increase of capital stock from $75,000 to $100,000. M. G. Smith is president of the company and L. M. Flesh secretary.

LIMA, OHIO.—The Lima Telephone & Telegraph Company is incorporated with a capital of $150,000.

MINERVA, OHIO.—The Stark Telephone Company has been granted a franchise for the operation of a telephone line in Minerva.

MONROE, OHIO.—The Stoddard Telephone Construction Company is organizing an independent telephone company in this city with a view to giving connections with the United States Telephone Company's long-distance circuit, besides the local service.

NORWALK, OHIO.—The Buckeye State Telephone Company, of Norwalk, was incorporated with a capital stock of $10,000, by C. D. Miles, F. H. Jones, H. E. Graham, J. R. McKnight and George H. Gates.

SIDNEY, OHIO.—The Sidney (Ohio) Telephone Company has increased its capital stock from $40,000 to $60,000.

SPRINGFIELD, OHIO.—The Home Telephone Company, of Springfield, with a capital stock of $30,000, has been incorporated at Columbus by B. F. Schneider, Philip Huonker and others.

SHARON, OHIO.— Citizens' telephone line in Sharon is to be rebuilt and refitted.

TROY, OHIO.—The Troy Telephone Company, Troy, has increased its capital stock from $40,000 to $75,000. A. G. Stouder is president and E. E. Pearson, secretary, of the company.

UTICA, OHIO.— Messrs. Kinter and Wilson have been granted a telephone franchise in Utica.

VENICE, OHIO.—The telephone line from Venice to Georgetown, to connect with the Bevis-Grosbeck line, is now assured will soon be built.

WILMOT, OHIO.—The Valley Telephone Company, of Wilmot, Stark county, was incorporated, with $1,000 capital stock, by J. W. Moyer, E. C. Cotton, H. F. Christman, J. O. Newcomer and A. L. Deal. They propose to operate telephone lines in Wayne, Holmes, Tuscarawas and Stark counties.

OKLAHOMA.

GUTHRIE, OKLA.—A charter was granted to the Sand Creek Telephone & Construction Company, of Sand Creek, for a period of ninety-nine years. The purpose of the company is to construct and operate telephones. The capital stock is $4,000 and the directors are J. A. Meyer, C. L. Bickerdyke, John Laing, A. H. McMahon and N. A. Silverthorn.

SAND CREEK, OKLA.—The Sand Creek Telephone & Construction Company was incorporated to operate a telephone line.

OREGON.

WHITNEY, ORE.—Articles of incorporation have been filed with the county recorder of Baker county by the Blue Mountain Telephone Company, of Whitney. The capital stock of the corporation is placed at $5,000; number of shares, 500; par value, $10 per share. The incorporators are Burton Miller, John M. Jones and Austin Crugar.

PENNSYLVANIA.

BUFFALO, PA.—The Eagle Gravity Telephone Company has been incorporated with a capital stock of $3,000,000.

THE ANNUAL MEETING OF THE INDIANA INDEPENDENT TELEPHONE COMPANIES' ASSOCIATION.

The annual meeting of the Indiana Independent Telephone Companies' Association will be held in Lafayette, Indiana, July 29 and 30. This will be the largest State meeting held by any State Association, and will be of great interest and benefit to those attending.

There will be papers and discussions upon subjects of vital interest to telephone people; there will be displays made by the leading manufacturers; there will be reduced rates at the hotel, headquarters being at the Lahr House; there will be a program of entertainment, such as trolley rides, vaudeville shows at the park, steamboat rides, music and a banquet, all of which will be free to telephone men.

As this is the home of our factory, we wish to extend an invitation to you in addition to that extended by the association. It matters not whether you are a member of the association or not. We want every man here that is interested in the independent telephone movement in Indiana. There will be no assessment nor charges, but a harmonious meeting for the advancement of independent telephone interests.

We earnestly and urgently request that your company be represented, and can assure you that we will endeavor to make your stay in our city profitable and pleasant. Notify your neighboring companies for fear we might overlook them. We want all Indiana telephone men to attend. Come and help make the independent telephone movement in this State the strongest and most united of any State in the Union.

Hoping to greet you July 29, we are,

Fraternally yours,

STERLING ELECTRIC COMPANY,

By W. E. DOOLITTLE, *Secretary.*

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WANT ADS.

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STOCK WANTED,
CAPITAL WANTED,
EXCHANGES FOR SALE,
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Telephone Magazine

VOL. XVIII. CHICAGO, AUGUST, 1901. NO. 119.

CALCULATIONS OF SIZES OF POLES FOR LINE-WIRE CONSTRUCTION.

Were it simply a matter of strength, irrespective of expense, the engineer would be a worthless commodity; and many men now enjoying a wide reputation for skill would find their talents a useless possession, no longer convertible into food and raiment, much less luxury.

During these days of the keenest competition, when the dollar saved means success, when competing corporations are forced to make their gains as much in the saving as in the gross receipts from their commodities, it has become a matter of the direst importance not simply to provide the article to fit the case, but to provide the most suitable article at the least expense.

This is true in bridge-building, railroad construction, telephone and telegraph construction alike; but peculiarly true of the third mentioned. It is with this line of construction that the present treatise is to deal. It is a comparatively easy matter for any one of ordinary intelligence to design a pole line that will be strong enough to resist all strains to which it shall be subjected; but it is the peculiar province of the engineer to design the pole line that shall be just strong enough to withstand the maximum strain to be imposed upon it with a reasonable margin of safety. It is this line that costs the least to construct and maintain, and such lines it is the aim of all operating companies to build, and for this purpose engineers have come into being.

Nor is it a single problem to lay out one pole line, and adapt it to all conditions. In Southern territories where gales are frequent, sleet and ice are scarce; in Western territories storms of different natures prevail, such as the sand storms on the prairies, which prove so disastrous to poles exposed to their fury; while in the East and North the greatest enemy to this kind of construction is the sleet storm, so familiar in New England, tho not unknown in New York and vicinity. Nor is the sleet storm so harmful in itself as when it is immediately succeeded by a gale of some severity, which is the usual order of things as observed by the writer.

The scope of this article will not extend to all possible cases, taking up each in detail; its purpose will be accomplished after dealing with the general problem, showing lines along which its solution should be pursued. Nor will it be attempted to deal with the entire pole line and the methods of construction; but rather will the effort be made to do no more than design the pole itself, considering the pole as carrying the entire load unassisted, that is, without guys, and ignoring the assistance of other poles in the same line; that is, a uniform load will be imposed on each pole, for, like a chain, the weakest pole determines the strength of the line, disregarding guys.

Upon considering the question it will be found that the maximum stress is brought to bear upon the line where it is straight, for the curved line is strongly guyed on its weak (or convex) side. Impose upon the line the conditions suggested, suffer the wires to be coated to the maximum thickness with ice and consider a gale of maximum velocity to succeed this condition, blowing in a direction normal to the line. There are exposed places upon our seacoasts where the prevailing direction of the wind is known, and the line is guyed in a manner to reinforce it against these conditions, but this is unusual.

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Authorities differ as to the pressure exerted by the wind at different velocities, but that discussion is beyond the scope of this article, and only the algebraic solution will be presented lest it provoke discussion upon subjects which, while relevant, are yet beyond the power of the average engineer to investigate. It seems to be the concerted opinion, however, that the pressure upon a cylindrical surface is but half that upon a flat surface exposed to the same wind conditions. Fortunately for those most interested the natural pole is of circular section, while sleet most considerately coats the exposed wire after the same fashion.

To attack the problem properly it must first be determined to what diameter the wire used in construction may become coated with ice, and to what velocity the wind may blow, accepting the figure of some reputed authority for the resulting pressure per square foot of exposed surface. Assume the length of span, the number of cross-arms and wires, the distance between the arms on the same pole and the distance from the roof of the pole to the top arm. Having determined the foregoing, it is possible to calculate the aggregate surface exposed to the wind; keeping in mind that the pressure on a cylinder is equal to that on a flat surface of the same length, but of which the width is equal to the radius of the cylinder. Thus, if d is the diameter of the ice-coated wire and l its length between poles (practically the distance between poles), the wind pressure upon each wire for that distance is $\frac{d}{24} l W$, where d is in inches, l in feet, and W is the pressure per square foot of plane surface due to a wind velocity of x miles per hour; x being the maximum velocity.

It is a fair assumption to make that all wires are exposed alike to the same wind pressure, so that the total lateral pressure brought to bear upon each pole from the wires alone is $n \frac{d}{24} l W$, where n represents the total number of wires in the line.

It may seem that this surface, $n \frac{d}{24} l$, would so far exceed the remaining surface of pole and cross-arms that the remaining surface may be neglected; but this is not true, however, for the usual length of span on a fifty-wire line, so that this surface must be increased. But for this the problem would be somewhat simplified; still, by a system of trial and adjustment, a close approximation can be made whereby the labor can be reduced.

Let us first determine this maximum load and point of application, and then proceed to the real problem.

Assume a wind velocity of 70 miles per hour, which, from Smeaton's formula, gives a pressure of 24.5 pounds per square foot of normal flat surface. $P = \frac{V^2}{200}$, where P is the pressure in pounds per square foot and V the velocity of the wind in miles per hour.

Assume that the wire is coated to a diameter of ½ inch, a span of 150 feet, five arms of ten wires each.

	Square Feet.
½ area (projected) of coated wires $= \frac{1}{2} \frac{50}{24} 150 =$	156.3
½ " " " insulators $= \frac{1}{2} \frac{50}{144} \cdot \frac{19}{8} \cdot 3 =$	1.2
Area of ends of cross-arms $= 5 \cdot \frac{4}{144} \cdot \frac{13}{4} =$	0.5
Constant area exposed to wind $=$	158.0

Pressure on 158 square feet at 24½ pounds = 3,871 pounds.

It must next be ascertained where this load is applied in order to determine its bending moment. For a five-arm pole, the center of pressure is obviously near

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the center of the third arm, or, in ordinary construction, about four feet ten inches from the top of the pole. This distance may vary but it will not affect the method, though modifying the results. We must now calculate a pole to bear this load, and then, as a second approximation, increase the load according to the extra surface exposed to the wind. We shall not correct for gaining and roofing of poles. For this purpose assume a diameter of seven inches (7″) at the top of the pole. The general equation for a pole to bear a given load is found from the well-known expression for the maximum fiber stress: $f = \frac{M y}{I}$, where f is the maximum outside fiber stress, M the bending moment at the section where f is taken, y the distance of the most strained fiber from the neutral axis, and I the moment of inertia of the section, taken about the neutral axis. Assuming a circular cross-section of radius and inches, the above expression easily acquires the following form:

$$f = \frac{48\ P\ (l - a)}{\pi\ r^3}, \text{ or,}$$

$$r = \sqrt[3]{\frac{48\ P}{\pi\ f}\ (l\text{-}a)} \qquad \text{(A.)}$$

Where P is the force applied at a distance "a" feet from the top of the pole, l is the distance of section where f is maximum from top of pole in feet.

We shall also consider that the elements of the pole are straight lines, or that the pole is the frustrum of a cone, of whose upper base the radius is 3½ inches.

Before proceeding with this solution let us depart somewhat and consider a question which immediately suggests itself, and must be clearly understood. After which we shall return to the problem here abruptly terminated and complete the solution.

If poles were sold by the cubic foot and the price per cubic foot were so great as to offset the labor involved in the manufacture, the commercial pole of the day would quickly give way to a mathematically constructed pole, whose shape and appearance will presently be described. No longer would we see a pole tapering after the fashion of the growing tree, but instead they would follow a mathematical law which it is our aim to deduce.

It is quite obvious that the chief aim of the designer would be to devise a pole that would have the required strength, and be of minimum volume. Such a pole would be of uniform strength along its entire length, that is the outside force stress would be everywhere equal.

Consider again the equation $f = \frac{My}{I} = \frac{P(l-a)y}{I}$, where P is the force applied at "a" feet from the top, l is the distance of most strained fiber from the top in feet, y and I are as before. Let r be the radius of the pole at a distance l feet from the top, in inches. Expressing I and y in terms of r, the equation becomes:

$$f = \frac{48\ P\ (l - a)}{\pi\ r^3}$$

$$\text{or, } r = \sqrt[3]{\frac{48\ P}{\pi\ f}\ (l - a)}.$$

If now we know P, f and a, we have r in such a form as $B\sqrt[3]{l-a}$.

As we are assuming that the outside fiber stress is everywhere equal, l becomes a variable, and by substituting different values for l we can find various values for r, and thus plot a curve showing the shape of the pole.

We shall assume P as known and fixed; f is the breaking strain of the material

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of which the pole is made, modified to suit the case; that is divided by the necessary factor of safety, which need not be high when imposing the very worst conditions.

It will be seen that B is equal to $2\sqrt[3]{\frac{6P}{\pi f}}$ for poles of circular cross-section; but later it will be shown that this alone varies upon changing the shape of the cross-section.

Upon considering the expression $r = B\sqrt[3]{l-a}$ we see that for all values of $l > a$ we have three equal roots, all positive; but it is quite evident that for every positive value of r we may plot a negative value, taking the axis of the pole as an axis of reference, and this will give a longitudinal section of the pole.

By taking suitable values of l and a we can now plot r. Let $a = 5$ feet; then let $l = 6, 13, 32, 69, 130, 221$ feet, etc.; then $r = B, 2B, 3B, 4B, 5B, 6B$ inches, etc., or the curve would look something like Fig. 1.

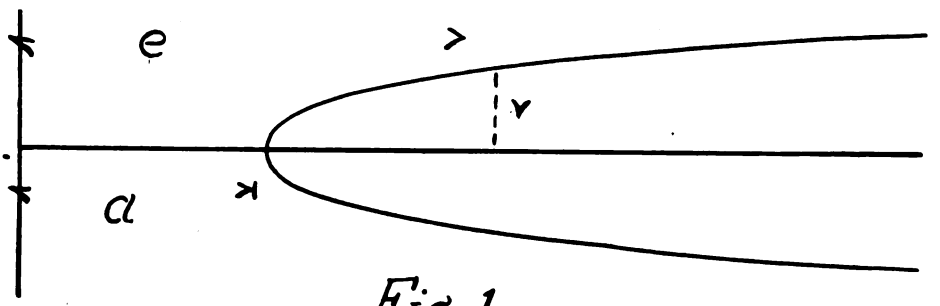

Fig 1.

It is quite apparent that when $l = a$, $r = 0$, so that this pole of uniform strength would terminate at a distance a feet from its top. The fallacy here is quite apparent, for the load P is not concentrated at the point a from the top, so that this part of the pole would have to be modified somewhat; but need not be considered here. Were such a pole a commercial pole this would be the pole of minimum volume; that is, would contain the least amount of wood fiber for a pole of circular section. But we are forced to depart from this mathematical pole when designing a commercial pole, for we must approach as nearly as possible the pole as it grows. Being forced to use a cone, therefore, we may apply the above principles to this cone and determine its taper, so that for a given load the pole may be as light as possible.

Returning to Fig. 1, it will be noticed first that to be as strong as this mathematical pole, the commercial pole must have $r_1 > r_2$ for all values of l, where r_1 and r_2 are the radii of the commercial and mathematical poles respectively. But the conical pole need not be stronger than the mathematical pole for all values of l; for some definite value of l r, may be equal to r_2, and it is this value of l that we must next determine. It is quite obvious that if $r_1 = r_2$ at one point only, while at all other points $r_1 > r_2$, then every element of the conical pole must be a tangent to the corresponding elements of the mathematical pole, and this point of tangency must be so chosen as to make the volume of the conical frustrum a minimum.

The equation for an element of the cone may be written $r = ml + b$, where r is the radius of any cross-section at a distance l from the top (assuming that the second axis of reference is a prolonged diameter of the top of the pole), b is the radius at the top, and m is the tangent of the angle that the element makes with the axis of the cone (half the angle of the cone).

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Should we assume a value for b that would determine m, by imposing the conditions $r = B\sqrt[3]{l-a}$, the condition of tangency. However, b is variable, and is to be determined from the condition of minimum volume.

In equation $r = ml + b$, m must equal $\frac{dr}{dl}$ of equation "A" $\left(r = B(l-a)^{\frac{1}{3}}\right)$, whence $m = \frac{dr}{dl} = \frac{1}{3}B(l-a)^{-\frac{2}{3}}$.

Therefore, $r = \frac{1}{3}B(l-a)^{-\frac{2}{3}}\, l + b$ is the complete equation for the element of conical pole.

Next we must find the expression for the volume, and impose the condition for a minimum. To do this a limit must be fixed for l; call it L.

b = radius at top $= r - ml$.
L = length of pole in feet.
y = radius of pole at the butt $= b + mL$.
$y = r - ml + mL = r + m(L-l)$.

From this the volume can be determined, or

$$V = x(b^2 + y^2 + by) \times \frac{\pi}{x} \cdot \frac{L}{3}. \qquad \text{(B)}$$

By substituting the values of b and y the equation becomes

$$V = \frac{\pi L}{3}\left\{(r-ml)^2 + [r + m(L-l)]^2 + (r-ml)(r + m\overline{L-l})\right\},$$

where $m = \frac{dr}{dl} = \frac{1}{3}B(l-a)^{-\frac{2}{3}}$ and $r = B(l-a)^{\frac{1}{3}}$.

It is quite obvious that B (a constant) is common to all terms and may be written outside the brackets, whence

$$V = K\left\{\left(\sqrt[3]{l-a} - \frac{l}{3\sqrt[3]{(l-a)^2}}\right)^2 + \left(\sqrt[3]{l-a} + \frac{L-l}{3\sqrt[3]{(l-a)^2}}\right)^2 + \left(\sqrt[3]{l-a} - \frac{l}{3\sqrt[3]{(l-a)^2}}\right)\left(\sqrt[3]{(l-a)} + \frac{L-l}{3\sqrt[3]{(l-a)^2}}\right)\right\},$$

where K is constant, and equals $\frac{\pi L B^2}{3}$.

Now V is a minimum for that value of l that causes $\frac{dV}{dl}$ to vanish, or when $\frac{dV}{dl} = 0$.

Neglecting the constant, $\frac{dV}{dl}$ becomes:

$$\left\{2(l-a)^{\frac{1}{3}} - \tfrac{2}{3}(l-a)^{-\frac{2}{3}}l\right\}\left\{\tfrac{1}{3}(l-a)^{-\frac{2}{3}} - \tfrac{1}{3}(l-a)^{-\frac{2}{3}} + \tfrac{2}{9}(l-a)^{\frac{2}{3}}l\right\} +$$

$$\left\{2(l-a)^{\frac{1}{3}} + (l-a)^{-\frac{2}{3}}(L-l)\right\}\left\{\tfrac{1}{3}(l-a)^{-\frac{2}{3}} - \tfrac{1}{3}(l-a)^{-\frac{2}{3}} - \tfrac{2}{9}(l-a)^{-\frac{5}{3}}(L-l)\right\} +$$

$$\left\{(l-a)^{\frac{1}{3}} - \tfrac{1}{3}(l-a)^{-\frac{2}{3}}l\right\}\left\{\tfrac{1}{3}(l-a)^{-\frac{2}{3}} - \tfrac{1}{3}(l-a)^{-\frac{2}{3}} - \tfrac{2}{9}(l-a)^{-\frac{5}{3}}(L-l)\right\} +$$

$$\left\{(l-a)^{\frac{1}{3}} + \tfrac{1}{3}(l-a)^{-\frac{2}{3}}(L-l)\right\}\left\{\tfrac{1}{3}(l-a)^{-\frac{2}{3}} - \tfrac{1}{3}(l-a)^{-\frac{2}{3}} + \tfrac{2}{9}(l-a)^{-\frac{5}{3}}l\right\}. = 0$$

or,

$$\tfrac{2}{9}(l-a)^{-\frac{1}{3}}l - \tfrac{4}{27}(l-a)^{-\frac{2}{3}}l^2 - \tfrac{1}{9}(l-a)^{-\frac{1}{3}}(L-l) - \tfrac{4}{27}(l-a)^{-\frac{2}{3}}(L-l)^2 - \tfrac{2}{9}(l-a)^{-\frac{1}{3}} \times (L-l) + \tfrac{2}{27}(l-a)^{-\frac{2}{3}}l(L-l) + \tfrac{2}{9}(l-a)^{-\frac{1}{3}}l + \tfrac{2}{27}(l-a)^{-\frac{2}{3}}l(L-l) = 0$$

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Multiply by $(l-a)^{\frac{1}{3}}$, and we get

$$\tfrac{4}{5}(l-a)l-\tfrac{4}{27}l^2-\tfrac{4}{5}(l-a)(L-l)-\tfrac{4}{27}(L-l)^2-\tfrac{8}{5}(l-a)(L-l)+\tfrac{8}{27}l(L-l)$$
$$+\tfrac{8}{5}(l-a)l+\tfrac{8}{27}(L-l)l=0$$

This easily reduces to —

$12l^2-18al-3lL+9aL-2L^2=0$, a simple quadratic, of which the roots are

$$l=\frac{18a+3L\pm\sqrt{(18a+3L)^2-432aL+96L^2}}{24}.$$

Having determined l in terms of L, the total length of pole, we can easily deduce b and y; also r, the radius of the section of maximum outside fiber stress.

It will be noticed that in this work we have considered simply circular cross-sections, but now let us see what modifications are introduced, should we use square or octagonal sections.

Reverting to the equation $f=\frac{My}{I}$, we must alter y and I to suit the new conditions for a square $y=\frac{1}{2}h=r$, where h is the side of the square, and $I=\frac{h^4}{12}$, or $I=\frac{16r^4}{12}=\frac{4}{3}r^4$, whence $f=\frac{Mr}{\frac{4}{3}r^3}=\frac{1}{3}\frac{M}{r^3}$, or

$$r=\sqrt[3]{\tfrac{3}{4}\frac{M}{f}}=B_2(l-a)^{\frac{1}{3}}$$

For an octagonal section $y=r$ (radius of inscribed circle), and $r=0.9239a_1$, where a_1 is radius of circumscribed circle

$$I=\frac{a_1^4}{6}(1+2\sqrt{2}),\text{ or as before}$$

$$a_1=B_1\sqrt[3]{l-a}$$

(a_1 must not be confused with a.)

We see, therefore, that the expression for the element of the standard pole may be written $r=B(l-a)^{\frac{1}{3}}$, whatever the cross-section, B alone varying.

Passing now to the volume of the frustrated pyramid or cone, it will be easily seen that $V=K(b_1^2+b_2^2+b_1b_2)$, whatever the shape of the base, where b_1 and b_2 are the radii of the inscribed, or circumscribed circle, of the upper and lower bases respectively, and K is a constant which changes to suit the case. Now it was seen on page 116 that the first derivative of the expression for the volume contained only L, l and a, so that the same result would have been reached for any cross-section, at least such sections that may be both inscribed in, and circumscribed about, a circle. We have thus established the equation

$$l=\frac{18a+3L\pm\sqrt{(18a+3L)^2-432aL+96L^2}}{24}$$

for all practical or commercial poles. Where

$$a=o,\ l=\tfrac{1}{24}(3L\pm\sqrt{105L^2})=\frac{L}{24}(3+\sqrt{105})$$

it may easily happen that b_1 becomes unduly small, or even zero in some cases, when it will be necessary to fix a limit for the diameter of the top. This simplifies the solution for all poles to which it would apply, for $b_1=r-ml$, and $b_2=b_1+mL$ $r=B(l-a)^{\frac{1}{3}}$ and $m=\frac{1}{3}B(l-a)^{-\frac{2}{3}}$, so that l and r are easily determined.

Having disposed of the method of determining the volume, hence the dimensions of the pole, let us now return to the determination of the extreme load that may be brought to bear upon the pole, not however without observing that when l

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brings the maximum fiber stress below the point to which the pole is buried, the pole may be reduced in size without weakening it.

On page 116 we were considering the wind pressure on the pole itself, and had assumed a pole with a 7-inch diameter at the top. We are now in a better position to undertake this solution. For our first approximation we had found $P = 3871$ pounds, $a = 58$ inches, or 4.83 feet. Assume f for the general case as 5,000 pounds per square inch,

$$B \text{ therefore} = \left(\frac{48 \cdot 3871}{3.1416 \cdot 5000}\right)^{1/3} = 2.28$$

$$b_1 = 3.5 = 2.28\,(l-a)^{1/3} - 0.76\,(l-a)^{-2/3}\,l$$

$$3.5\,(l-a)^{2/3} = 2.28\,(l-a) - 0.76\,l$$

$$= 1.52l - 2.28a = 1.52l - 11.$$

Whence $l^3 - 9.66l + 23.33 = \dfrac{(1.52l-11)^3}{42.88}$

$$= \frac{3.51l^3 - 76.2l^2 + 5.52l - 121}{42.88}$$

This assumes the form of $Al^3 + Bl^2 + cl + D = 0$, whence l can be determined.

It is ofttimes easier to solve a cubic equation by trial, when it assumes such a form as $(l-a)^2 = \dfrac{(1.52l-11)^3}{42.88}$.

Without finding the true value for l we shall assume that the nearest whole number is 25 feet, whence r is easily determined.

We now have a new surface to calculate, a trapezoid, whose area is $\frac{1}{2}l(2b_1 + 2r)$, whence the pressure can be determined, of which the point of application must be determined. It should be kept in mind that this area is the projection of a conical frustrum, so that the pressure must be half of that on the same flat surface. The center of pressure is at the center of gravity of the surface.

We now have one force P_1 acting at a point 4.8 feet from the top of the pole, and a second force P_2 acting at a point x feet from the top of the pole, where

$$x = \frac{b_1 + 2r}{b_1 + r} \cdot \frac{l}{3}$$

We must next find what force, P_3, acting 4.8 feet from the top, gives the same moment at l feet from the top that P_2 does at x feet from the top.

Obviously $P_3 = \dfrac{P_2(l-x)}{l-4.8}$

Wherefore the total force acting at a point 4.8 feet from the top of the pole is $P_1 + P_3$. We must now determine l anew, and see what changes occur. It may not be necessary to make another adjustment, for P_3 will be only a small part of P_1, and a change of 10 per cent in P_3 will not affect $P_1 + P_3$ to any appreciable extent.

A repetition of the foregoing to apply to the cases of square and octagonal poles is scarcely warranted in a treatise of this nature, nor is it widely different in any respect except that the wind pressure on a square or octagonal pole is different from that on a round pole. In the case of a square pole it is simply double that of a round pole, of which the diameter is the side of the square. With the octagon, however, we have one flat surface, and two equal surfaces inclined at an angle of 45 degrees. For such surfaces one formula in good favor is $p = p_1 \sin^2\theta$, where p_1 is the pressure upon a normal surface of equal area.

It has been the aim of the writer to eliminate as far as possible all unnecessary calculations, as the purpose of this treatise is to present one method of treating a familiar problem, rather than to solve the problem, reaching results which would be useless to a large proportion of those to whom this article may be presented. One

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point must not be overlooked in work of this sort: keep the practical side constantly in view and modify theory wherever necessary.

In determining the ultimate size of an ice-coated wire never exceed the conditions under which the wire itself would yield. Thus a wire coated to a diameter of ½ inch may hold in a gale of 70 miles per hour, while one coated to a diameter of 1 inch would not; so that the resulting pressure on the pole is limited rather by the strength of the wire than by the climatic or weather conditions.

One fact becomes apparent here, that the massing of the wires into cable greatly reduces the pressure arising from the above causes. It will be seen that the tension in the wire introduces no additional strain in the direction of the load we have considered. This is true only in the straight line, while in the curved line the wind pressure can not attain to the figures given.

In this discussion no account has been taken of the strengthening property of the guy; but too much confidence must not be placed in the efficacy of the guy, for in the experience of the writer a guy made fast to the trunk of a tree was apparently the cause of the line's destruction. During a gale the line was pulling away from the tree, but could not give, until all at once the tree went, and the line, suddenly released, went with a snap. It is reasonable to believe that, had the guy been missing, the line would have swayed in the wind without yielding.

We have not confined ourselves in this study to any special material, so that our resulting formula will apply to cedar, chestnut and pine alike, to any length of pole of any cross-section, with the load applied at any distance from the top of the pole.

Nor have we considered any factor of safety in the determination of proper sizes of poles. Let us consider for a while this phase of the problem. One excellent method of allowing a factor of safety is to make provision for a definite amount of rot or decay in the pole, at the earth line, where it is exposed to the worst conditions. Assuming that ten years is a sufficient life for the pole, allow one-tenth of an inch (radially) per year for rot, then in ten years the diameter of the pole has decreased two inches at the ground. This can be taken care of in the calculations, and thus the line does not fall within the limit of safety for ten years.

Should the heart of the pole be attacked first, the pole does not weaken so rapidly; a fortunate circumstance, as this decay is not apparent to the inspector.

For special cases, special poles must be used, necessitating a special design for each case, such as terminal or corner poles; but in any event the method of procedure described herein may be applied, by using the proper constants and modifications.

SUBTERRANEAN TELEPHONING.

The success that has attended the laying of the subterranean telegraph cable between London and Birmingham, a distance of 112 miles, has prompted the postal authorities to utilize the cable for telephoning. This is considered to mark the limit of underground telephoning with the existing apparatus, says the *Scientific American*. Several of the other leading provincial towns, such as Liverpool, have petitioned the postal authorities to connect their cities with London by a direct subterranean cable, such as that running to Birmingham, but their requests have been refused until a method of transmitting underground telephonic messages over long distances is found. The British Postoffice is gradually providing a reliable telephone system thruout the whole of the United Kingdom by the aid of the telegraph wires. For this purpose $10,000,000 has been authorized by Parliament, a large portion of which sum, however, is being expended upon the London telephone system, which it is expected will be partly in operation in the autumn of this year. The competition between the Government and municipal telephone systems on the one side, and the National Telephone Company, which has hitherto enjoyed a monopoly, on the other side, is very keen. One town in the south of England, the first to possess a municipal telephone, has been the means of reducing the charge from $50 to $20 per year.

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NOTES ON A HUMMING TELEPHONE.*

By F. GILL.

My excuse, if one be needed, for bringing this matter before you, must be that our late revered chairman, Prof. FitzGerald, was interested in the matter when it was brought under his notice, and further that, so far as I have been able to ascertain, the behavior of the humming telephone, as I hope to show it, is new and has not been published hitherto. This note is merely a record of a few experiments carried out at odd times since the effect was first noticed two years ago.

The ordinary humming telephone is, of course, well known, and was first noticed by A. S. Hibbard, of the United States, in 1890. We have Hall effect and Ferranti effect, why not Hibbard effect?

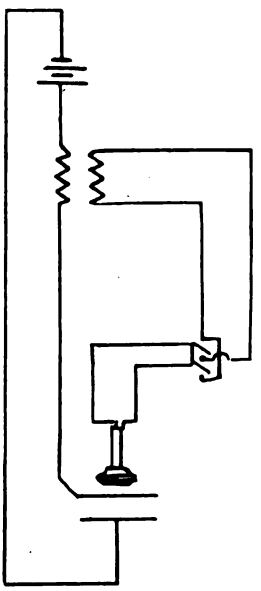

FIG. 1.

In Hibbard's experiment a telephone is held against or near to the diaphragm of the microphone and a hum or whistle is set up and continues. (Experiment.) A rough explanation of the experiment is that in the first place some slight noise is taken up by the microphone and the sound is, in the usual way, given out by the telephone, but because the latter is near the microphone the sound waves set up by the telephone affect the microphone, which in turn again acts upon the telephone, and thus the reaction is maintained.

The connections in this case are those ordinarily used in telephony, Fig. 1, where the microphone is in series with the battery, and with the primary of the induction coil; the telephone is in series with the secondary of the induction coil, and I have added a reversing switch.

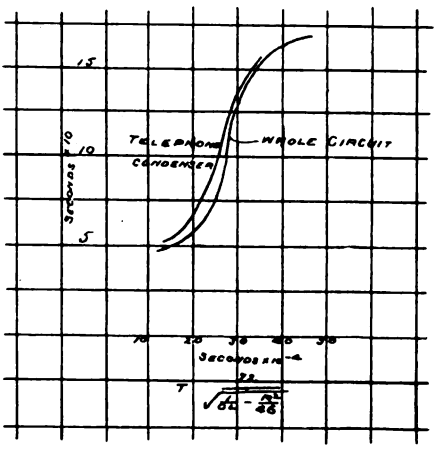

FIG. 2.

The feature which I believe to be new is that if the wires leading to the telephone be reversed while the instrument is humming, the note at once changes in a striking degree (experiment), and if the hum is stopped it will recommence again high, or low, according to the side the switch is set. (Experiment.) It is also to be noted that the high note starts more easily, and is altogether more vigorous than the low note. Of course, reversing the current in the primary circuit also produces the same change in pitch, and if the primary and secondary circuits be each reversed simultaneously no change is observed.

Returning to the ordinary humming, the exact conditions which determine the note given by the telephone appear to be most complex, apparently every portion of the circuit and instruments has a share in what the note shall be,

*Paper read April 18, 1901, before the Institution of Electrical Engineers (Dublin Section).

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but the note can most easily be varied in one of the following ways:

By altering the conditions of the circuit by adding resistance, capacity or self-induction. Speaking generally, if a non-inductive resistance be added into the secondary circuit the pitch of the note goes up, and at the same time the sound becomes weaker by attenuation. In this experiment I think there is a good deal of condenser effect across the winding of the coils of the resistance box, which is used as a non-inductive resistance.

Adding capacity across the telephone lowers the note. (Experiment.) It is quite easy to compare roughly different capacities in this manner; for instance, in trying this, three condensers of .96, 1.1 and 1.3 microfarads respectively were at once picked out in their proper order, the condenser with the lowest capacity giving the highest note. (Experiment.)

thereon side by side for about 2,000 turns. The capacity between the two wires is .06 microfarads, and the self-induction of each coil is .1. If the connections are made to the wires entering at, say, the left-hand end, the note is higher than if connected to opposite ends, as in (b); in one case the difference was from 2,280 to 2,120 vibrations per second. This is due to an alteration in the induction, which is less when the wires enter at the same end, as in (a), than when they enter at opposite ends, as in (b), and consequently the note given in (b) is lower. Conversely, the addition of resistance in parallel (leakage) lowers the note, and self-induction in leak or capacity in series raises the pitch.

The note may also be varied by altering the current in the microphone. Increase of current causes the note to become very slightly lower in pitch. (Experiment.) The strength of the

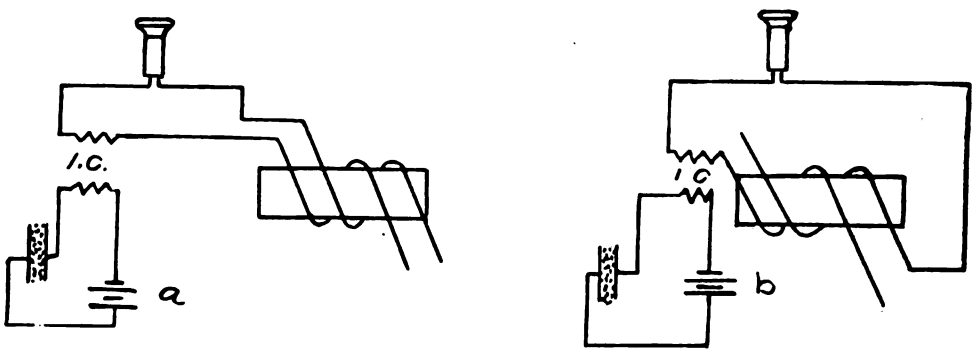

FIG. 3.

The curve shown in Fig. 2 gives the result of adding capacity. The time of the note observed is plotted with the period of the whole circuit, neglecting the primary circuit, and is separately plotted with the period of the telephone and condenser only. The curve is given as a result obtained on a few trials, and I do not attach any fanciful importance to it. Adding self-induction to the circuit lowers the pitch of the note. (Experiment.)

I show an interesting case. The secondary circuit is open as in the Fig. 3 (a), and is connected to a coil without iron and having two wires wound

field may be varied and alter the note. (Experiment.) In this experiment the arrangement is as in Fig. 4.

As usual, the primary and secondary circuits are used, but a condenser is in series with the telephone. Across the telephone itself is a shunt circuit of a battery and a self-induction. This allows the strength of the pole pieces of the telephone to be varied while in use. The self-induction in the shunt circuit prevents too much of the humming current being shunted out of the telephone. If the current from A is supplied so as to strengthen the magnets of the telephone, the note goes up in pitch, and

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becomes louder, while if the current is sent in the reverse direction, almost at once the hum is stopped. In the telephone tried (an Ader), the current, strengthening the field, was varied from 8 to 112 milliamperes, and showed a rising note; when, however, 17 milliamperes were sent round the telephone in the direction to weaken the magnets, the hum ceased. If a current be used to strengthen the field, the humming generally may be the more readily set up.

Variation of the distance between the two diaphragms gives an alteration in the note. On the high-note side, increased distance gives higher pitch. On the low-note side, as the distance between the two diaphragms is increased the pitch rises until a sudden change occurs in the character of the note. If a tube be used to confine the air waves, the difference in the note at different distances is striking. Pressure inwards on the telephone diaphragm causes the pitch of the note to increase.

The following are briefly mentioned as points which have been observed:

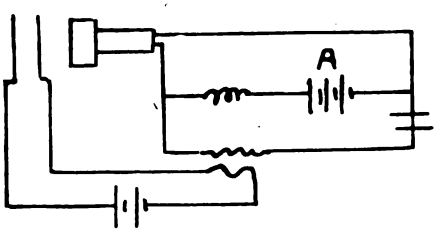

FIG. 4.

In some cases the hum will not commence until the current in the microphone has fallen to a certain value. The current in the microphone in a number of cases was about .18 amp., being about 28 per cent less when humming (low note) than when at rest (.25 amp.), and 40 per cent less (.15 amp.) when giving the high note with no external circuit.

I am indebted to Mr. W. W. Cook for the following interesting case. In a common battery circuit as shown, Fig. 5, and using a hand microtelephone, it is possible to set up the hum, altho in this case the diaphragms are not opposite to each other and are distant 8¼ inches. The vibrations are undoubtedly conveyed thru the handle. He states that he has easily heard this effect thru 330 feet in the open air.

Mr. Duddell has been good enough at very short notice to put the current in the telephone thru one of his portable oscillographs, and he gives the following approximate results (I understand the primary current was at 16 volts); this, of course, was high, and probably he used so high a pressure to enable him to get an easily observable curve immediately. Current r.m.s. 15 milliamperes at the low frequency, on reversing the telephone connections frequency about doubled.

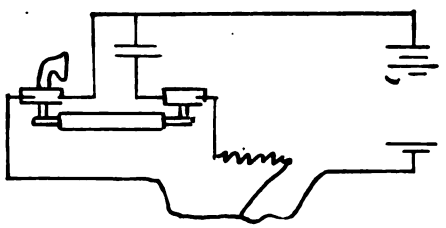

FIG. 5.

The pitch of the note appears to be determined by the length of the column of air between the two diaphragms and the conditions of the circuit. As the periodic time of the circuit is increased the note falls in pitch. To some extent the pitch is governed by the rate of the diaphragms, but I do not think this is so important a factor as the others. The main factors appear to be the angle of lag, and the length of the column of air between the diaphragms. Altho the vibration is a forced one, it would almost seem that its rate is largely dependent on the free period of the circuit.

With regard to the alteration in the note when the telephone connections are reversed, Mr. Tatlow has suggested that this may be due to the fact that according to the direction of the current in the telephone its diaphragm will be moved in the same direction as or in an opposing direction to the diaphragm of the transmitter, and that while the former would tend to prolong the movement and so make a lower pitch, the latter would tend to force the rate. Altho this seems probable, yet I have

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been unable to satisfy myself as to exactly what happens. It would appear also necessary to take into account that when the telephone diaphragm moves away from the magnet during increase in current, the self-induction of the telephone circuit is falling, due to the movement of the diaphragm, and there exists what may be compared to a negative resistance.

The humming telephone seems to be very similar to the humming arc so ably dealt with by Mr. Duddell, and shown by Dr. Trouton, and its study by those who are ably provided with the necessary means of investigation would repay the labor.

With great diffidence, I venture to give what appears to happen, from my observations:

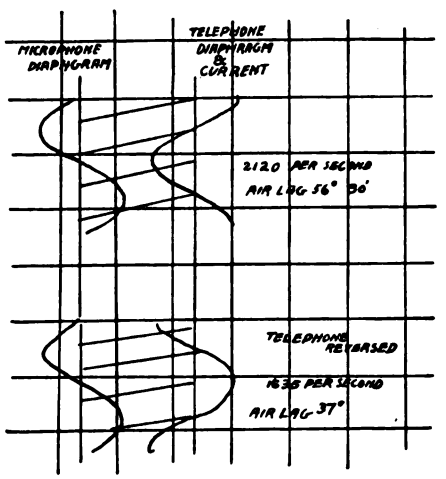

FIG. 6.

When the microphone diaphragm moves in, the current increases, but owing to lag the increase in current does not coincide with the movement of the diaphragm. The telephone diaphragm apparently more or less accurately follows the current, and sends out its air waves; these waves, however, take an appreciable time to reach the microphone, and there is consequently an air lag, as well as an electrical lag. So far as I can at present see, the high note is given when the diaphragm of the telephone moves (at the appropriate lag) in the *same* direction as that of the microphone ((telephone, and the low note is given when the motion of the diaphragms is ( ). The diagram, Fig. 6, is an attempt to illustrate this. The figures taken are N = 2,120 periods per second. L = .166. R = 145. The curves are drawn with a phase difference of 86°, and with a distance of 1 inch between the diaphragms, the air lag is 56° 30′. The diagonal lines show the air lag. The figures with the telephone reversed are n = 1635, L = .166, R = 145, phase difference = 84°, air lag = 37°.

It would be desirable if one of the masters would tell us what really is the maximum frequency which should be allowed for in telephone work. Dr. Pupin says 750 periods per second is the highest that need be considered; Max Wien states that the most characteristic notes of the voice lie between 500 and 3,000 per second, and Dr. Perry "as an exercise" takes 1,000 as the figure; one does not associate with Dr. Perry the taking of a figure, even as an exercise, unless he has sufficient ground for so doing.

Besides those mentioned above, I would specially wish to tender my thanks to Dr. Trouton, Mr. Sinclair, Mr. C. J. Phillips and Mr. France. I also desire to thank Mr. J. M. Shackelton for the very great assistance he has given.

APPENDIX.

The following measurements may be of interest:

Ader Telephone —
- Resistance, 145ω.
- Self-induction at 10 milliamperes, .134.
- Diameter of diaphragm tinned, 2.13 inches.
- Thickness of diaphragm tinned, 8 mils.

Decket Microphone —
- Resistance at rest, 10ω.
- Resistance at high note with circuit of induction coil and telephone, 33.5ω.
- *a*Both of these figures taken from ampere-meter readings.)

Induction Coil —
- Primary resistance, 1.05ω.
- Secondary resistance, 25ω.

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Secondary self-induction at 22, milliamperes, .032.

Frequency of note in three observations. Primary volts, 4 —

As in Fig. 7, high note, 2,120 vibrations per second.

As in Fig. 7, low note, 1,635 vibrations per second.

As in Fig. 7, high note side, but with 3.4 microfarads across telephone, giving low note, 620 vibrations per second.

Amplitude of vibration of diaphragm of Bell telephone. Primary bolts, 4—

As in Fig. 7, high note, 1 × 10.3 mm.

As in Fig. 7, low notes, 6.6 × 10.3 mm.

As in Fig. 7, high note side but with 2.4 microfarads across telephone giving low note 12.6 × 10.3 mm.

As in Fig. 7, another trial, 16.5 × 10.3 mm.

Frolich gives the amplitude for a Siemens' loud-speaking telephone as 35 × 10.3 mm. and v. Wietlisbach gives the amplitude of a Siemens' telephone (apparently not loud speaking) for "a loud tone" as 52 × 10.6 mm. with a current of 12 × 10.4 amperes.

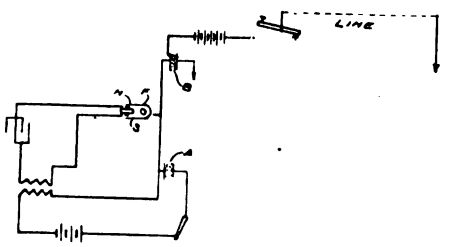

FIG. 7.

Mr. Porte suggested that the note was largely controlled by the fundamental note of the diaphragm of the telephone.

Dr. Trouton asked if the saturation of the iron in the telephone had any marked effect on the pitch of the note in Fig. 4 when the field was varied. If the iron is very highly magnetized and is capable of taking up more energy and, in fact, becomes almost a non-magnetic substance, the self-induction of that circuit diminishes and the period goes up. If the iron is saturated by the magnetizing current shown in Fig. 4 the induction is diminished by the saturation. He thought that the carbon contacts in the microphone had probably a free period of their own.

Mr. Ruddle drew attention to the importance of the telephone diaphragm. When the field was strengthened, as in Fig. 4, the tension of the diaphragm (when the current was in one direction) was increased and consequently the pitch was raised. In the same way a weakened field meant reduced tension on the diaphragm.

Mr. J. E. Taylor (communicated) gave experience as to his work on similar telephones, especially in connection with the Postoffice system of wireless telegraphy using Dr. Lodge's magnifying telephone. He pointed out that if the microphone and telephone use the *same* diaphragm and using the connections of Fig. 7, but with a condenser in series in the secondary circuit, the alterations produced by varying the electrical conditions of the circuit became very evident.

He had used for a constant frequency transmitter for wireless telegraphy that shown below.

The transformer used was about eight inches long, with a ratio of about 1 to 10, and had an iron wire core.

In operation the instrument was perfectly free in action and self-starting on closing the circuit of the driving microphone, even when only one dry cell was used. With three or four cells it gave out a most powerful note. To obtain the best result it was necessary for the self-induction and capacity of the secondary circuit to be so adjusted as to give it the same period as the fork, namely:

$$\text{frequency of fork} = f = \frac{1}{2x}\sqrt{\frac{1}{KL} - \frac{R_2}{4L_2}}$$

or, approximately, $$f = \frac{160}{\sqrt{LK}}$$

where L = henrys and K = microfarads.

Using a fork of 300 per second, the best result was with a condenser of 2.5 microfarads. Taking f at 300; K at 2.5, $L = \frac{160^2}{f^2 K} = .113$ henry, which, as near as could be judged, was the actual inductance of the secondary.

Altering the fork by loading or otherwise necessitated a corresponding alter-

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ation to the condenser to give best results. Increasing the primary current necessitated adjustment on account of the increased induction in the iron core.

This instrument has been employed by him for the investigation and measurement of inductances at telephonic frequencies on Lord Rayleigh's bridge method. By its use the increase of R in the primary circuit of a transformer on closing the secondary, as distinguished from the diminution of L, can be measured with accuracy and expedition. The two effects can be easily and simply separated from each other by separate balancing, using, of course, a telephone receiver in place of the bridge galvanometer. This is mentioned as an application of the principle.

In the United States the hum is used as a test that the speaking set is in good order.

He understood that Mr. Rolls Appleyard had designed a self-maintained tuning-fork, but was not aware whether the principle and construction were the same as above described.

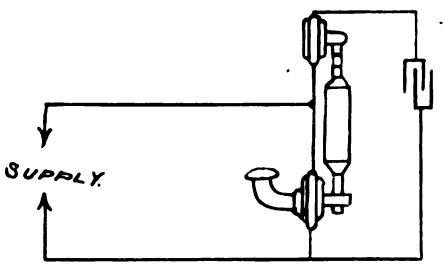

FIG. 8.

Mr. W. W. Cook (communicated) pointed out that the connections in Fig. 5 might be simplified as follows, where the telephone and microphone are simply in parallel with a condenser in the telephone branch. The resemblance between this circuit and that of Mr. Duddell's musical arc is very striking, but so far as he had ascertained the pitch does not correspond to the time constant.

When the telephone and microphone are joined mechanically the results differ from those obtained, then there is an air gap; for instance, the difference in note when the receiver is reversed, in the microtelephone experiment, is only two semitones, but all seems consistent with the explanation put forward by Mr. Gill. He thought the shape of the wave observed by Mr. Duddell was interesting.

Mr. Gill in reply: As to the fundamental note of the diaphragm in the bell receiver this was about 5,000, and he thought it was not a leading factor. From the experiments he had made, he was of the opinion that the iron in the telephone was not saturated in the experiments described under Fig. 4, and hardly thought the effects described by Dr. Trouton could have very great effect. As regards tension of the diaphragm he pointed out that if the diaphragm were pressed the note went up, but in the reversal effect there was nothing to cause increased or diminished tension of the diaphragm. He thought Mr. Taylor's communication was most interesting indeed. Probably one reason why it was possible to obtain agreement between experiment and calculation in the arrangement described was because the note to which Mr. Taylor's instrument responded was a fixture, whereas in the usual arrangement the note was free to vary, and did vary tremendously.

HIGH TELEGRAPH POLES.

What are said to be the highest telegraph poles in the United States, if not in the world, have recently been erected at Beaumont, Texas, by the Western Union Telegraph Company. Two poles stand on the opposite bank of the Neches river and support the telegraph company's cables so as to permit the passage of vessels thru a drawbridge. The span measures 144 feet. The poles are of iron skeleton construction.

UNITED STATES AHEAD IN PATENTS.

The number of applications for patents in the United States increased from 3,002 filed in 1899 to 3,189 filed in 1900. While this country has increased, it is interesting to note that there has been a falling off in the number of patents granted to citizens of Great Britain, and also to citizens of Germany and France.

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SUIT TO TEST 'PHONE LAW.

Should the Chicago Telephone Company fail to heed the opinion of Corporation Counsel Walker that it can not charge $175 a year for its "improved service," a number of business men threaten to at once begin mandamus proceedings to compel the company to adjust its rates to the maximum figures specified in its franchise ordinance — $125 a year for business and $100 for residence telephones in the North, South and West towns.

The company as yet has taken no steps to alter its rates, and President Sabin intimated last night that no such action might be taken until the courts so command.

"A prominent business man of Chicago has assured me that he and several other business men will unite in sending a letter to the company and demanding that they adjust their rates to the 1889 schedule," said Alderman Freeman K. Blake. "They expect the company to refuse, and in this event I am instructed to begin mandamus proceedings at once. We will see that the ordinance is enforced and rates lowered."

"We have taken no steps to alter our rates," said President Sabin. "As to any legal action on the part of subscribers — well, we shall cross that bridge when we reach it."

Illegal charges and inferior service are two of the reasons the Illinois Manufacturers' Association will allege in support of its mandamus suit to compel the Chicago Telephone Company to restore the franchise rate of $125 a year for business telephones. The company's additional charge of $50 annually is based on the added cost of metallic circuits, long-distance instruments and superior switchboard service. None of these things, the association will contend, entitles the company to ask $50 annual rent in excess of the legal rate of $125.

Metallic circuits, Secretary John M. Glenn declares, are necessary to the handling of the volume of business done by the Chicago exchange. In support of his statement he cites the fact that the old-fashioned ground circuits are no longer installed, even when the subscriber refuses to pay more than the legal rate. The induction incident on the use of thousands of grounded wires would destroy the efficiency of the telephone system altogether.

Subscribers, he thinks, ought not to be asked to pay the cost of improvements which are absolutely essential to the growth of the company's business, without which the number of its subscribers would be limited to thousands instead of hundreds of thousands.

Refusal of the company to install wall instruments renting at the franchise rate, except when threatened with legal action, is another of the abuses which the manufacturers' suit will air in court. Secretary Glenn is collecting evidence to show that the Chicago company has declined again and again to install the telephones at $125 a year, and has discouraged their use by neglecting to answer calls sent in over the $125 wires. Up to a few months ago, too, the company charged $10 for an extra name in its directory. Now it demands $35 a year, and the association will ask where it gets its authority for such an exorbitant rental.

Attorney John W. Creekmur, who is a neighbor of Mr. Glenn's on the fifth floor of the Marquette building, has had some experiences with the company which will furnish ammunition to the association in its fight. After using a measured-service telephone for more than a year and discovering that his telephone bills amounted to more than $150 a year, Mr. Creekmur asked the company last April to put in one of the $125 instruments, on which the company secured a renewal of its franchise in 1889. His request was ignored until the middle of June, when he threatened to stir up trouble for the company in the City Council. "I'll ask the aldermen from my ward to start an investigation of your methods," Mr. Creekmur told the telephone officials, "unless you put that telephone in immediately."

He got his telephone the next day, but ever since he has had trouble getting connections. He waited an hour and thirty-five minutes for an answer to a call Thursday morning. Then he started his friends, the aldermen, after the

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company again and now his service is almost as good as if he were paying the illegal tribute of $50 extra demanded by the company. When his office mate, W. Foster Burns, asked the company to insert his name in the telephone directory he was told that the additional name would cost $35 instead of the $10 extra demanded a few months ago.

Lloyd G. Kirkland, 112 Dearborn street, has had experiences parallel to Mr. Creekmur's.

James W. Nye, managing partner of Ducat & Lyon, 201 Lasalle street, says that even the payment of $175 rental does not insure decent service.

"The advertisement of the Chicago Telephone Company that 'the mail is quick, the telegraph is quicker, but the telephone is instantaneous,' is a bald fraud," Mr. Nye explained. "Why, we wait ten minutes for a connection sometimes, and get the busy signal many times when the party we called had a free line. I know that, because I've taken the trouble to compare notes with some of our customers, discovering that their lines were clear when the exchange girls said they were busy. I guess the company ought to employ more switchboard girls."

Secretary Glenn declares that it is absurd for the company to charge an extra $50 for improved service. "How would it look if any of our great railroads, which are allowed to charge 3 cents a mile for passage, would tack on an extra cent for using air-brakes on their passenger trains? Air-brakes are no more necessary to fast passenger traffic than are metallic circuits and improved instruments to telephone business in Chicago.

"The association is in this fight to win, and win right away. Levy Mayer is our attorney. He is in New York now, but if he doesn't return soon we will ask his firm, Moran, Mayer & Mayer, to push the case without delay. If the company appeals, we'll carry the matter to the Supreme Court. No matter what it costs we will demand our rights, and know full well that the courts of the United States will uphold us in getting them."

WIRELESS TELEGRAPHY.

The evolution of the wireless telephone is making rapid strides in the hands of the German physicists. E. Ruhmer, whose ingenuity seems to know no bounds, has modified both the transmitter and the receiver in a radical manner. After pointing out that a small current intensity in the "speaking arc" is bad for acoustic effects, but very good for the fluctuations of luminous intensity used for transmission, he proceeds to dispense with the arc altogether, and substitutes for it a chalk or zircon block mounted on the telephone diaphragm itself and heated in the usual way by means of an oxyhydrogen flame. The slight vibrations of the telephone disk suffice to alter the position of the luminous body in the flame, and thus to vary its luminosity in a manner suitable for the transmission of speech. At the receiving station the high resistance of selenium cells has hitherto presented a difficulty. The author gets rid of it by substituting for the selenium cell a "radiomicrophone," a kind of carbon coherer mounted in the focal line of a parabolic mirror. The differences in temperature produced by the impact of the light upon the carbon are sufficient to actuate a telephone receiver. The author also suggests a bolometer as a receiver.—*E. Ruhmer, Phys. Zeitschr.*, March 2, 1901.

POLISHING RECEIVER SHELLS.

It is often desirable to repolish receiver cases. This is something that is very easily done and by closely following this an old receiver may be made to look like new. Remove all scratches with ooo sandpaper, and if a lathe can be used, the work can be done more rapidly. Chuck one end of the case in the lathe and slide the center up against the ear-piece opening. Do not have the lathe running at too high a speed or it will burn the work. Apply pumice and water with a stiff brush; after washing the pumice off, polish with whiting and a soft brush. Lampblack and oil applied while the work is running in the lathe will give a very high polish, or the bare palm of the hand may be employed to give a good finish.

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WIRELESSNESS.

BY EDWARD J. WAKEMAN.

(*Continued.*)

Wireless telegraphy gives worse results on land than at sea, for the following reasons: A coherer placed underground is not influenced by electric waves, which proves that the curvature of the earth constitutes an absolute barrier to wireless telegraphy. Moreover, even if buildings, trees, and generally all irregularities of the ground are pervious to electric waves, it is certain that there is considerable absorption of energy. While at sea, the experiment of Fleming has shown that electric waves pass thru the water with an absorption proportional to the quantity of salt and the thickness of the water; the curvature of the earth does not interfere until the straight line joining the two stations begins to touch the bed of the sea.

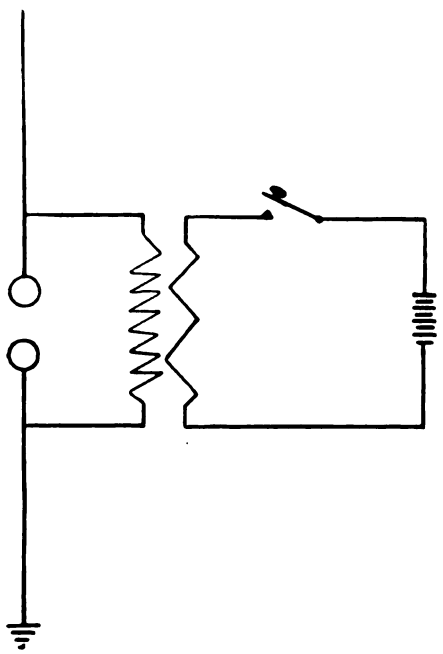

FIG. 1.

To enable wireless telegraphy to communicate on land to any distances, however great, without increasing the cost of installation, some other method than that used at present must be employed. This fact has been grasped by M. Guarini, of Brussels, and the ideas and experiments which he now brings forward appear such as will shortly bring us to the end of the transition period. In order to understand the work of M. Guarini, we will first pass rapidly in review the work of his predecessors, and consider the state of wireless telegraphy at the present moment.

As is known, the present systems are all based upon the following principle: To produce at the transmitter a signal, the electric spark, and register it at a distance on a receiver, which utilizes the properties of metal filings, powdered carbon, or imperfect contacts. All these systems employ as a transmitter an oscillator inserted in the secondary of a Ruhmkorff coil, the primary including the source of electricity and the Morse key; further, in the systems derived from the Marconi system (Fig. 1), one of the balls of the oscillator is connected to an entirely separated "feeler" upright, and the other is put to earth; in the Slaby-Arco systems (Fig. 2) the feeler is connected to earth.

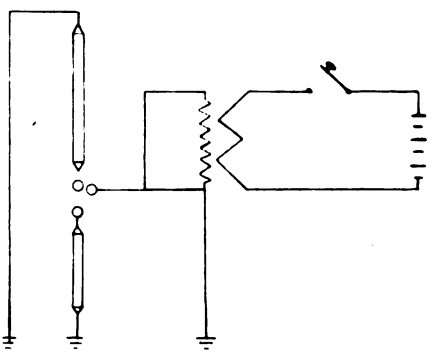

FIG. 2.

In either case, we notice that the improvements in similar transmitters consist in the increase of ratio between the power of the signal and that of the source of energy. This necessarily has a limit, since a portion of the energy set in action is transformed into heat and light in the spark. In order to obtain a greater radius of transmission, the power of the source, the size of the Ruhmkorff coil, and the height of the feelers must all be increased. It was by these means, according to the report of Captain Ferrié on the experiments in the Channel, that Marconi has obtained at sea the transmission over 50 km. (30

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miles) with an upright of 37 m. (120 feet), a coil of 25 cm. (10 inches) spark, and a battery of 100 cells (of 1.5 volts and of 0.15 ohm interior resistance) and of eight light accumulators, giving at the primary terminals a difference of potential of 16 to 17 volts and a current of 6 to 9 amperes in this circuit. With a coil of 50 cm. (20 inches) spark and an upright of 50 m. (170 feet), Slaby-Arco has obtained on land transmission over 15 km. (9½ miles).

The power of the coil and the height of the upright feeler can not, however, be indefinitely increased. If we plot the cost of maintenance on a diagram (Fig. 3), of which the abscissæ represent either length of spark or height of feeler, we shall notice that the curve bends rapidly, turning its convex side toward the axis of the abscissæ, and that it be-

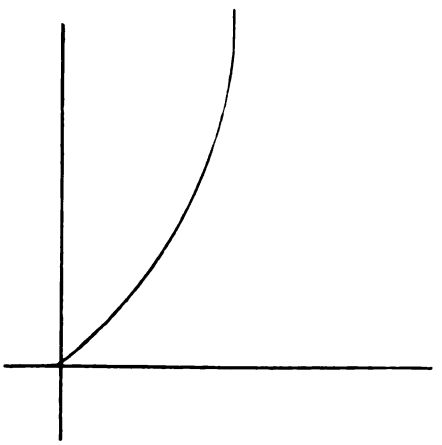

FIG. 3.

comes asymptotic in relation to the ordinates.

M. Guarini has obviated this difficulty in the following manner: He does away with the oscillator entirely, and substitutes alternate currents only in the transmitter. To obtain this, the upright feeler is connected directly to one end of the secondary of the Ruhmkorff coil, the other end being put to earth (Fig. 4). This arrangement economizes that part of the energy transformed uselessly into heat and light in an oscillator. Besides, other things being equal, the range of transmission is greater with an alternate-current transmitter than with a spark transmitter. We shall see the confirmation of this in the Brussels-Malines-Antwerp experiments. When the distance separating the two transmitting and receiving stations is too great for the size of apparatus employed, M. Guarini makes use of the repeater which he has invented. The employment of a suitable number of repeaters placed at intermediary posts or offices enables any distance on land to be overleapt, however great, and there is besides the advantage of some economy in the maintenance of installations.

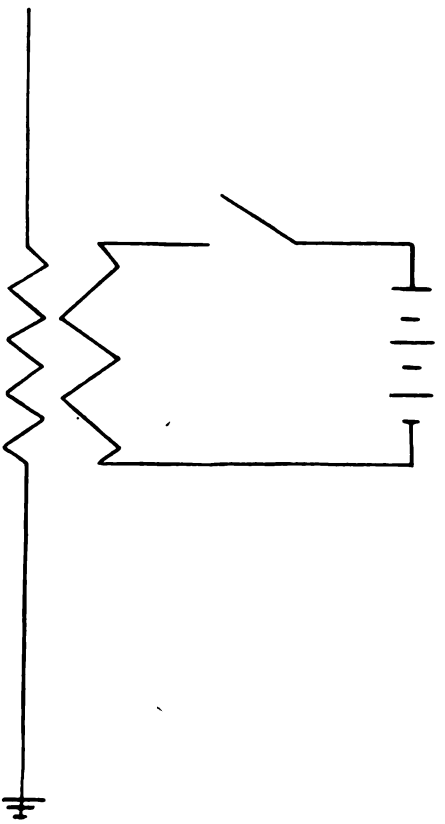

FIG. 4.

Practice has demonstrated that this curve has the same rise as that of Fig. 3. Let X be the distance separating the two stations. If it is desired to clear this distance direct, this will give a cost of maintenance equal to the ordinate Y; while if this distance is divided, for instance, into five equal portions, by placing repeaters at the intermediate points,

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x_1, x_2, x_3, x_4, we obtain a cost of maintenance equal to $y_5 = 5\,y_1$. The economy achieved is thus equal to $Y - y_5$, which increases with the distance, X. This reasoning is evidently only exact on condition that the establishment of the five intermediate posts does not cause increase in the cost of staff. As we shall see, M. Guarini has achieved this in actual working in long-distance transmission with his automatic repeater, where, thanks to the presence of this apparatus at an intermediate post at Malines, he has been able to establish communication both ways between the two terminal stations of Brussels and Antwerp.

The property of metal filings is the basis of almost all the receivers for wireless telegraphy, of which the Marconi apparatus is the most complete type; the coherer, connected to the upright feeler by means of an induction coil and a condenser (jigger), is inserted, together with a telegraphic relay in the circuit of a battery cell; when under the action of the electric waves the filings become conducting, the exciting circuit of the relay is closed. This latter works a Morse receiver at the same time as the shaking apparatus brings the coherer back to its original resistance. As accessory parts, we find the metal box, the self-induction coils, and the non-inductive resistances, which are for the purpose of hindering the extra-current sparks, or the electric waves themselves, acting upon the coherer or the electromagnets at an inopportune moment.

In his receiver, Tommasina uses the auto-decohering property of carbon; his coherer is inserted in the circuit of a battery telephone receiver, one of whose poles is connected to the upright feeler and the other to the ground.

Schäffer uses an arrangement which has the reverse property to those using metal-filing coherers or carbon coherers. In normal conditions this arrangement (a pellet of silver having numerous fine slits covered with damp felt) allows the current to pass, but its resistance increases under the influence of electric waves, returning to its original weak resistance when the waves cease (Fig. 5).

Whatever the systems employed, some special arrangement must be introduced to keep the secrecy of the telegrams. Tommasi has invented the following arrangement, based on the relationship which he believed he had found between the distance separating the oscillator balls and the range of the Hertzian waves. At the transmitting station two complete transmitting instruments are connected to a single upright feeler, which is thoroly insulated. One of these works in the following manner:

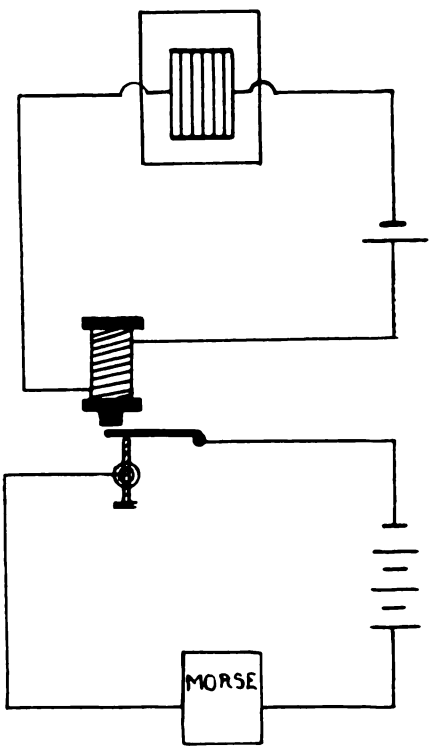

FIG. 5.

The separation of the balls is regulated in such a manner that the distance reached may be a little less than that to the receiving station; all the receiving instruments situated within the zone of action of the first transmitter will therefore be acted upon continuously, and an undefined bar will be registered on their Morse strip. The separation of the balls of the second transmitter is regulated according to the exact distance of the destined receiving station. The working of this second transmitter is regular,

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but its signals, being intermingled with the continuous signal of the first on all the Morse strips of the intermediate receivers, will be registered alone on the destined receiving instrument. But even if his principle were not verified in actual practice, as M. Guarini has found in his Brussels-Malines-Antwerp experiments, this system is incomplete, as all the stations situated at the same distance as the destined station will intercept the telegram as well as this latter itself.

Marconi has solved the question by syntonization (or tuning), basing his experiments on the formula of Thomson,

$$T = 2\pi\sqrt{LC}.$$

He connects the upright feeler to the primary of an induction coil, of which one end is put to earth; in the secondary he inserts the coherer and a condenser. This arrangement which he calls a "jigger," allows him to vary the capacity C and the coefficient of self-induction L, and thus to make the receiver syntonic or in tune with the transmitter of the same station. He then makes one station in tune with another by modifying the capacity of the feeler by placing strips of metal near it, which strips can be brought near or separated from the upright feeler.

This system is also incomplete, as the formula of Thomson only applies to the principal oscillation, and does not take into account those secondary oscillations analogous to the harmonics of a fundamental note in acoustics. According to the report of Captain Ferrié already mentioned, these secondary oscillations might be felt up to 2½ km. (1½ miles). M. Guarini has found that they may reach 22 km. (14 miles). With this system, multiplex and simultaneous telegraphy is impossible both ways, as the receiving apparatus would have to be at least 2½ km. from one another not to be influenced by the corresponding transmitter.

M. Guarini secures the secrecy of telegrams by an altogether different expedient. The electric waves emitted by the upright feelers of the transmitting station radiate in a direction normal to the surface of the feeler and in every direction. By a special arrangement of the feelers M. Guarini limits the electric radiations into a narrow sheaf, which he directs toward the receiver feeler; all the regions of space not comprised within this sheaf of rays are not affected by the action of the rays. The receiving feeler itself is arranged in such a way as to receive only the radiations emitted by the feeler of the transmitting stations.

These feelers are constituted in the following manner: A central core, formed of a wire or of a metallic cable, is carefully covered with insulation and wrapped in a metallic sheath over the insulation; a longitudinal slit is made in the sheath. This sheath feeler is used by M. Guarini in the following way:

The core is connected either to one of the oscillator balls or else direct to one end of the secondary of the Ruhmkorff coil, according to whether Hertzian currents or alternate currents are used for the transmission. The outer sheath is put to earth. In this case only that portion of the core opposite the longitudinal slit sends forth its radiations into space. Indeed, the currents given out by the transmitter being at high tension, it is enough to recall the following experiment in electrostatics. A pith ball A, suspended by a silk thread, is violently attracted by a metallic screen B, as long as a neighboring body C is charged with positive electricity, for instance; but the pith ball remains quiescent if the screen is put to earth. If C represents the core of the Guarini feeder and B the metallic sheath, the same electrostatic phenomena are reproduced opposite the open portion of the sheath. All the space comprised within the sector *a* on *b* is therefore screened from the action of the electrostatic field.

If the transmitter makes use of alternate currents in closed circuit, the circuit wire is formed by the core and the return wire by the sheath, metallically connected to the core. In this case, those portions only of the core opposite to the slit give forth radiations into space. Now let us subdivide the cylindrical core into Z elements (cells),

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traced according to the generators; let Z^1 be the number of such elements opposite the sheath; then there are $Z-Z^1$ elements of the core, which correspond to the longitudinal slit. Let us connect together the Z^1 elements of the core, one by one, and by their upper parts, with the Z^1 corresponding elements within the sheath. At a given moment, each couple of elements thus formed is traversed by a current in one direction in the inner element and in the contrary direction in the outer element. The resultant of these equal currents is nil, and there is no exterior field. The space corresponding to the open portion of the sheath is therefore deprived of all magnetic field, only the $Z-Z^1$ elements of the core opposite the slit have any exterior field.

If the transmitter uses low tension in open circuit, the sheath is insulated from the ground, and the core is connected to one end of the secondary of the induction coil, the other end being put to earth. In this case the part of the core opposite the slit gives forth into space a concentrated sheaf of radiations. M. Guarini gives the following reason for this: One portion of the current induced in the sheath is transformed into heat, the other portion, not being able to radiate into space, by reason of the peculiar formation of the sheath, nor yet to dissipate into the earth, as the whole system is insulated, must be used up in some way or other, according to the law of conservation of energy. This part is utilized by an induction on the core itself. The latter, at a given moment, is traversed by an inducing current in a certain direction, which induces a current in the contrary direction on the sheath, and this latter current partially, in turn, becomes inducing current for the core. This induced current in the core is added to the inducing current, which is in the same direction. The Ruhmkorff coil will give us a striking example of this phenomenon. If we prevent the energy of the secondary from being dissipated in heat and light in the spark, by putting the two secondary terminals on short circuit, we find an immediate heating effect at the interrupter of the coil; the portion of the energy originally utilized in the spark is now spent in reacting on the primary.

To sum up, the sheathed feelers invented by M. Guarini enable us to limit the space in which electric radiations are transmitted, and thus to insure secrecy of telegrams; they may even, in the case of low-tension open circuit, be concentrated into a sheaf.

WIRELESS TELEGRAPHY IN THE UNITED STATES NAVY.

The board of naval officers, headed by Captain Chadwick, appointed to make a full investigation and report on wireless telegraphy, has completed its work and submitted its report to Admiral Bradford, chief of the Naval Bureau of Equipment, having charge of this subject. It had been expected that the inquiry would last thru the summer, and the Navy Department has been somewhat surprised at the promptness with which the board has been able to reach its conclusions. Altho the findings are not made public, it is known that the board reports on the entire feasibility of the system, and recommends that it be adopted and that the present system of using carrier pigeons for messages between naval points be abandoned.

With the report the board submits the results of an extended conference with Señor Marconi, the Italian inventor, concerning the general subject of wireless telegraphy. It is understood that Marconi made no proposition regarding his own system, and that the board secured his views as an expert on the general subject. There is no finding in favor of any particular system, but a general treatment of all systems. The board has no doubt that wireless telegraphy will prove a valuable adjunct for the navy.

WIRELESS TELEGRAPHY IN THE BRITISH NAVY.

The Majestic, flagship of the Channel Squadron, had a remarkable experience in the matter of signaling by means of wireless telegraphy while on the voyage from Portsmouth to Berehaven, where she arrived. Messages were exchanged up to a distance of ninety miles between the Majestic at sea and the Hector in

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Portsmouth harbor, until at 11:45 P.M. the telegraph communication was unexpectedly suspended. The instruments on board the Majestic were then adjusted to send a message to Portland, and to the surprise of the signaling staff that station was found to be talking to the Hector, the latter explaining that it had suddenly lost touch with the Channel Squadron flagship owing to the breakdown of the apparatus key. The distance at which this information was taken was 103 miles as the crow flies, a record so far as the naval service is concerned. Probably the space thus covered would have been exceeded had not the Diadem at Plymouth interrupted, thinking that the Majestic was calling her. The achievement must be extremely gratifying to the naval officers who have worked so assiduously in the development of the system of wireless telegraphy for signaling purposes at sea, and likewise to the trained signalmen of the fleet who show an intelligent interest in the experiments and have learned to manipulate the apparatus expertly. An order has been issued in the Channel Squadron that only the flagship is to keep her wireless instruments ready for sending and receiving in harbor, the other ships disconnecting their coherers.

WIRELESS TELEGRAPHY IN THE SPANISH NAVY.

Wireless telegraphy is attracting considerable attention in Spain. Experiments are being made with a system invented by Colonel Cervera. With wireless telegraphy it is hoped to establish communication with the Balearic Islands and the Spanish possessions in Africa. The Marquis of Portago, director-general of communications, has asked the Government for funds to carry on the experiments.

(To be continued.)

DESPATCHING TRAINS BY TELEPHONE.

Mr. Thomas E. Clarke, an old-time telegrapher, now general superintendent of the Delaware, Lackawanna & Western Railroad Company, at Scranton, Pennsylvania, has decided to run the trains on a portion of his system by telephone instead of by telegraph, as at present.

The work of installing a complete telephone system along the line of the Morris and Essex division of the road is being pushed with all possible despatch. It is the intention of the company to equip each station with a complete telephone system to be used in the place of the present telegraph system in transmission of orders pertaining to the arrival and departure of trains, the officials believing that greater accuracy and saving of time in the carrying out of orders can thus be secured. It is proposed to equip the various branch lines first and then, after a careful trial, if the plan is found to be satisfactory, the main lines will be fitted out.

This new departure will in no wise effect the present working force of railroad telegraphers, for in the majority of stations along the lines of the Lackawanna road the operator also performs the duties of ticket and freight agent, and at those stations where individual operators are employed the force will still be maintained, as it is not the intention of the company to discontinue the telegraph system, except so far as it applies to the despatching of trains. Superintendent of Telegraph L. B. Foley, who has charge of this work, states he is unable to say just how soon the new system will be in operation, but the work is being hurried as fast as possible.

Telephone lines have been constructed from Hoboken to Washington, N. J.; from Hoboken to Morristown, N. J., to be extended to Dover, N. J.; from Tobyhanna to Gouldsboro, Pa.; from Hallstead, Pa., to Binghamton, N. Y., and from Scranton to Clark-Summit, Pa., over all of which trains will be moved by telephone. These lines cover the portions of the railroad system where the traffic is very heavy. For the purpose of despatching trains regular "19" and "31" train order blanks will be used. In order to insure safety and to record the train orders transmitted by telephone a phonograph will be placed in each circuit, the wax cylinder being large enough to record twenty-four hours' work.

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The Chicago Telephone Company and Their Exorbitant Rates.

Legal action has been taken by the Illinois Manufacturers' Association to restrain the Chicago Telephone Company from charging the exorbitant rates they now demand for telephone service in Chicago, and to compel the Chicago Telephone Company to conform with the schedule of rates set forth by the City Council January 4, 1899.

The Chicago Bell Telephone Company in 1889 accepted a franchise in which a schedule of rates was stated. They are now charging for unlimited service more than twice the stipulated rates. It stated in this franchise that violation of any part of it shall waive the whole, so consequently we find the Chicago Telephone Company doing business in Chicago without a right, and what is more, charging a rate that is not right. So we find the Bell Company again defying the laws of the city and common council with impunity; and "even further," the president of the company says, "we have taken no steps to alter our rates, and as to any legal action on the part of our subscribers, well, we shall cross that bridge when we reach it." We would advise the Chicago Telephone Company to have a care, for a telephone company, in crossing the troubled waters of a municipality, should at least not attempt to cross the river until they have a franchise that has not been violated, and this this company does not possess.

Telephone Rates.

In another part of this paper will be found a description of a telephone device which measures the actual time a telephone has been in use, so that the company may charge the subscriber for the actual service he has had. This appears luminous, and causes us to ponder what will be the method of charging the telephone service in the future; whether it will be so much per call for incoming calls, or so much a call for both incoming and outgoing calls; or whether it will be just merely the charge for the calls originating at the subscriber's point. Or would it be charged as so much per minute. There are many

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advantages to each individual rate plan, so it is hard to hazard an estimate what is the proper method. Measured service at so much per call has been tried and in some respects found wanting. So, we may yet have to resort to the old method of a straight rate.

The Mutual Company.

The effect of mutual companies upon independent telephone exchanges in the rural district, while first considered a thorn to small exchange managers, has now become one of the greatest booms to independent telephony that it has ever had. The mutual company generally originated among several farmers, who had built farmers' lines to secure telephone connections with each other. After they had built the lines and had the 'phones in operation, they saw how valuable telephone service was; so, naturally, they formed a mutual company and extended their lines and prepared to receive connection with their adjoining town or village. All the farmers in the vicinity had been eager to get 'phone connection, so they were all placed upon this one line. The consequence was, it was a faulty and overloaded line, and when they ask the independent exchange to give them connection they refused because they did not care to connect to their poor line. The consequence was, the farmers organized thruout the little city a mutual company. This, of course, was in opposition to the independent company there. After this mutual company was organized they found that for several reasons they could not give as good service as the independent company, so the mutual company fell into the hands of the company already in the town, with the result that the independent company became possessed of a greater number of subscribers than they had before the advent of the mutual company. And as well as that, the mutual company had educated the community as to the value of telephone connection, and instead of a thorn, the mutual company had become transposed into a rose.

The Bell Company Losing Ground in Indiana.

The Bell Telephone Company in Indiana has been steadily going down hill for five years and has only about one-third as many 'phones as the Independent Telephone Union in that State. Obviously, it does not pay in the long run to try to gobble everything.

A FLUX FOR SOLDERING ALUMINUM.

In a letter to the *Engineer* recently, Mr. J. V. S. Bickford, the manager of the Bickford Burners Company, stated that the firm had previously submitted a sample of a new aluminum soldering flux, together with a specimen of work done, but as they saw no prospect of doing good business in this flux, they decided to abandon it and publish its composition.

To continue in Mr. Bickford's words: "The flux submitted consisted of about ninety per cent lard oil with 10 per cent of disguising material, mostly paraffin wax. Any oil almost will solder aluminum, but animal oils are best. The flux submitted, we believe, was made with Price's 'animal' oil.

"All that is necessary in using lard oil for soldering aluminum is to take the greatest care as regards cleanliness. Grit or the slightest trace of dirt on the tinning of the copper bit are quite fatal, and the process is rather slow. That is, a strip of aluminum six inches long and ½ inch wide takes about one minute to tin, but after tinning it may be soldered to another similarly tinned strip as readily as tin-plate.

"It should be mentioned that 'the use' of mixtures of stearic and oleic acids has been patented for this purpose, but we are informed by competent legal authority that lard oil does not infringe his patent."

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TALKS AND CROSS-TALKS.

BY THE INSPECTOR.

HINTS TO CORRESPONDENTS.

Write on one side of the paper only, and make sketch or diagram, when necessary. Endeavor to give all the facts bearing on the case, so as to enable the editor to answer intelligently.

Name and address must accompany each letter, not for publication, but for the information of the publisher.

All letters addressed to the department after August 1 will be answered promptly by mail and will also appear in these columns. The great volume of inquiries that are coming in compels us to take this step, as under the present method our readers are frequently compelled to wait thirty days for answer to their inquiry, and this is sometimes not very desirable, so that we feel that this method which we intend to adopt will meet the hearty approval of our readers.

121. We have a grounded bridging line 30 miles long from central to central, and both ends of line is on a bridging extension bell, and I want to leg off at the middle of the line two bridging 'phones a distance of four poles parallel with the trunk line. Will it make any difference if I take off two legs, or would it be better to leg only one line?

In your case it would be cheaper to do this on one leg and will not make any difference in efficiency, so naturally would advise course illustrated in Fig. 1.

122. How should the transpositions be made on a line as shown in Fig. 2?

I would advise you to transpose in the manner shown in Fig. 3; that is, making a complete transposition every quarter of a mile, starting where the two lines are parallel. You will see in the drawing that the transposition is taken up as soon as each additional line is fastened on one pole. This should remedy your trouble.

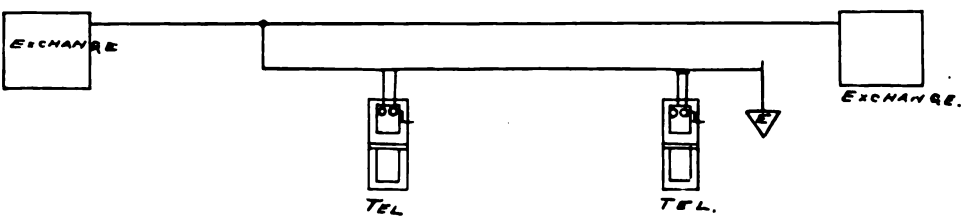
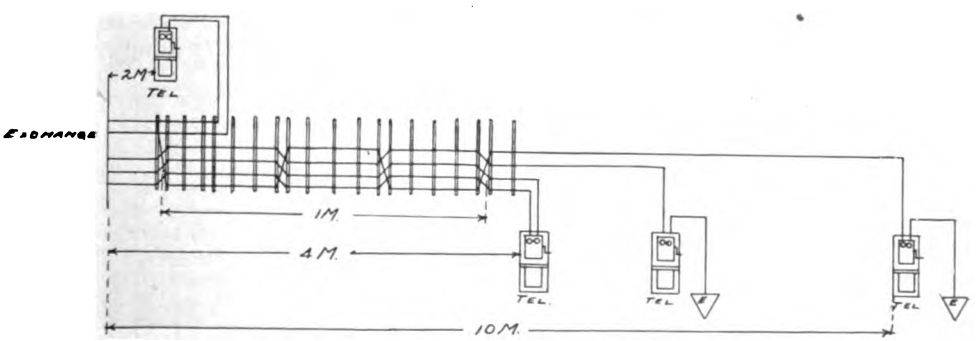


FIG. 1.

123. Fig. 4 is a sketch made to represent ten 1,000-ohm magneto bells connected in multiple. Taking an alternating current at A, if the bell C were replaced would it be more difficult to ring the bell B than with the 1,000-ohm bell at C, using the same generator in both cases?



FIGS. 2 AND 3.

The high resistance bell placed in circuit as you described would not affect

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the ringing of the bell B', but if you were to reverse this condition and substitute 2,000-ohm bells all along the line and insert at C a 1,000-ohm bell, it would be the only bell on the line that would ring, as the current would flow along and pass over the stretch of the least resistance, which would be the 1,000-ohm bell.

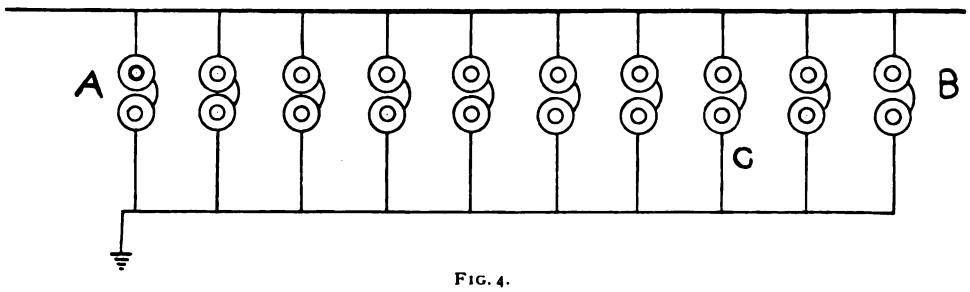

FIG. 4.

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124. We have here a trunk line between two lines three miles apart; the trunk line parallels a trolley line the entire distance with arc power and find wire on our poles which produce a great amount of disturbance in our circuits. This disturbance is at the worst when the arc current is on. Can you advise me of some remedy. Our trunk lines are full metallic No. 12 iron, free from grounds, and transposed regularly according to the American Telephone & Telegraph Company's plan.

I would suggest to you that you enter into your cord circuit on your switchboard a repeating coil, or you could connect a repeating coil at one end of each trunk line. This should remedy your trouble.

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125. In answer to No. 120, June edition, you say: "Of course, you could not obtain simultaneous telegraphy and telephony with a grounded line." I would like to ask with reference to this if you could not obtain simultaneous telegraphy and telephony by using the following diagram and explanation? If not, why not? Now, referring to Fig. 5, C and C retardation coils 800 ohms, R and R relay 800 ohms, K and K keys, B and B telegraph battery, G ground, C condensers, 1 and 1-2 telephone ringers 1,600 ohms. Circuits 2, 3 and 4 are just like No. 1 and A. If, for instance, we are at station A, it would at first seem as if our telephone current would affect the home telegraph instrument, but our telephone current would be so weak compared with the telegraph current it would have but very little, if any, effect. The retardation coils would prevent the telegraph current from raising itself from its minimum value to its maximum value, and vice versa, suddenly, and would prolong it and would do so to such an extent as to prevent any click in a receiver should one be in use. The condensers would permit no direct current to go thru the telephone instrument. Therefore it seems that very good service could be obtained in this manner.

Of course, we will concede all, and while you have the Inspector down why "throw it into him"? What he meant when he said you could not obtain simultaneous telegraphy and telephony was this: The party who inquired desired to use the material he had on hand, and that is how the Inspector made the statement that you could not obtain simultaneous telegraphy and telephony. The Inspector is glad to number among

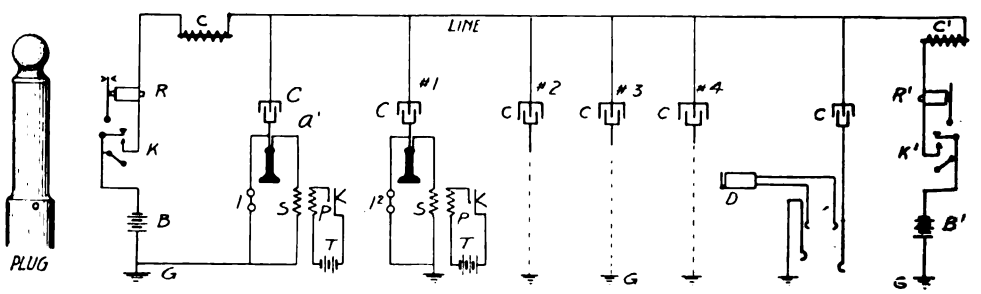

FIG. 5.

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his readers a gentleman like you, for at all times we can not be infallible, and the Inspector does not object to being shown; in fact, he rather likes it, so would be pleased to hear from you again.

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126. You will pardon for asking such a simple question as I am going to, but all the boys have had an argument on it and I would like to hear from you as to what is a multiple board.

In a large exchange there are a great number of subscribers, and to each operator there is laid out a section. Each operator has 100 annunciators to take care of, and in her section there is a jack for every line entering that exchange. These jacks are connected with their corresponding number on every section in multiple, so that when a call comes in the operator has immediately beneath her annunciators a jack of any number in the exchange.

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127. Seeing a great many of your readers sending drawings of circuits to you to be published, I take the liberty of showing you a little idea I have in regard to a magneto call system. My idea is of using a central energy visual as a line signal, thereby doing away with the shutters that are necessary with the generator drop, and at the same time acting as an automatic restoring drop. Probably you have thought of this before, but we will take it for granted that you have not. In

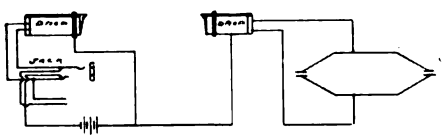

FIG. 6.

Fig. 6 you will see a drawing of the jacks, the lines, the jumpers to the signal, and the batteries that operate the signals; in the first place, one side of the batteries goes to the jack, from the jack to the signal thru on a jumper; the other side goes direct to the signal. As you see, there are two springs on the top of the tube, so that when the armature is raised it closes the contact, but when it falls its weight pushes one spring down away from the other and opens it. So far we have that when the subscriber rings with his generator it raises the armature, allows this spring that is down to fly up against the other one, closing the contact and allowing the battery current to flow thru the signal, which keeps the coil magnetized and holds the armature up until the operator plugs in. When she plugs in it disconnects the current in the jack, allowing the line signal to fall, at the same time making a connection with the plug on to the jack side of the battery, which flows thru the cord to the clearing-out signal, from the signal to the other side of the battery, so that when the subscriber rings off the clearing-out signal acts as the line signal did. When the plug is pulled out it disconnects the clearing-out signal and cuts in the line signal, but the armature is down and the contact on the drop is open, so the subscriber has to ring in before the visual will rise. Another clearing-out signal is that when the plug is inserted it causes the X side of the battery to flow out over the line, coming back on the other side down the cord to the clearing-out signal, from the signal to the side of the batteries (this style of clearing-out signal has no springs on the drop, but just the plain drop). As long as the subscriber has his receiver off, the clearing-out signal is down, but when he hangs up the receiver it closes the battery circuit and raises the clearing-out visual. When the plug is pulled out it cuts out the clearing-out signal which is central energy and cuts the battery up into the line signal which is generator coil. Altho I have not made this very plain, as a telephone man you can understand my meaning. Hoping in your next issue I shall see what you think of this, I remain. A READER.

P. S.—This is no guess; this is a fact.

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128. I have a bridging telephone line five miles long with ground return, with ten telephones on one wire. On the opposite side of the street, and buried, is a telegraph cable which is parallel with the above line for three miles. The air space between the two lines is at least thirty feet. The messages on the cable are heard so distinctly on the telephone line that one can hardly talk. Is there any remedy except metallic circuit?

I would advise you to connect at one end of the line a repeating coil. If after you try this and it fails to do away with the disturbance, I would be pleased to hear from you again, as I am at present experimenting with a case similar to yours and would be pleased to hear the results from you.

---

129. In building a line out of this place we have an obstacle to overcome which we can not satisfactorily determine the best plan to pursue. The Arkansas river, which is about one-half mile west of this place, must be crossed with toll line. The river for several miles either way is one-fourth mile wide, medium low banks on either side but about high-water mark. River being very sandy it is almost impossible to erect poles in the bed of the river that will stand the force of the freshets. We do not at present want to cable under river on account of revenue being too

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small to expend so much by so doing. What would you suggest as the best plan to pursue? Hoping that I have made the matter plain to you and that you may suggest some way to overcome this trouble, for at present we will use either No. 10 or 12 best galvanized wire.

I would recommend that No. 10 soft-drawn aluminum wire be used. This wire would stand the strain and would be the cheapest in the long run, or if you did not use aluminum I would recommend a wire called phono-electric. If you desire to use any one of these I would be pleased to let you know by mail where you could secure either one of these wires.

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130. In the April number of your TELEPHONE MAGAZINE, under the heading of "A New Farmers' Line Plan," in "Talks and

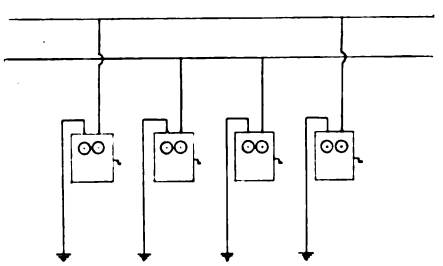

FIG. 7.

Cross-Talks," there is a description of an arrangement whereby the calls on the party line can be made at will between either of two line wires and the ground. I have used a somewhat similar plan on a line not connected to a central with, I think, one important improvement, namely, the use of a two-point push-button spring switch placed in the inside of the bell box, the button being on the left side of box just above the receiver hook. There were no means provided for fastening the switch in any but its normal position; it was therefore impossible for the subscriber to leave his bell connected to the wrong wire. When calling a subscriber not on the caller's line, he presses the button and holds it in place until the call is answered, then releases it, and by taking the receiver off of the hook automatically cuts his bell out and connects his talking circuit between the two line wires. By this arrangement twice the number of 'phones can be successfully used than would be possible for circuits connected in the ordinary manner, as shown in Fig. 7. Altho not a telephone expert, I had but little difficulty in inserting the switches and changing the wiring to fit above conditions. Fig. 8 shows wiring on back of bell box as seen from rear; dotted lines indicate connections inside of bell box. 1 and 2, transmitter binding-posts; 3 and 4, battery binding-posts; 5 and 6, receiver binding-posts; 10 and 13, to bell coils, 10 connects with lever spring in bell box, which cuts out bell when hook is up; 7 connects with hinged end of hook lever; 8 and 9 connect with two spring switches at end of lever; 11 and 12 connect thru automatic shunt to ringer coil; 12, 14 and 18 are thru terminals of push-button switch, 12 being fixed end of spring, 14 the upper and 18 the lower points; 7 and 9, line wire binding-posts; 8, ground wire binding-posts.

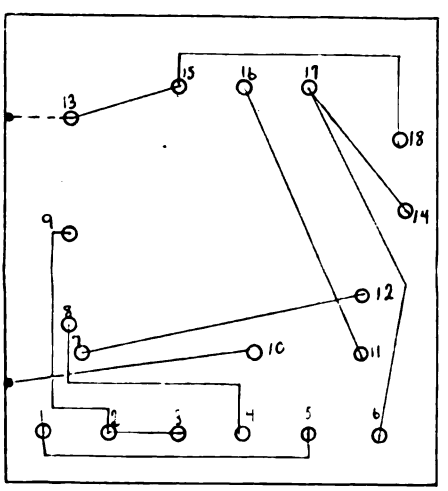

FIG. 8.

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131. I would like to ask a few questions about treating steel for generator and receiver magnets. (a) How hot should magnet steel be heated for tempering? (b) Which is best to dip it into, oil or water, and how should it be dipped? (c) How should they be magnetized? Would a motor field do, or would something else be better? (d) Should they be aged, and how should that be done? (e) What books would you recommend for a further study of the subject, something that is not too deep?

(a) Magnet steel should be heated to a cherry red in an inclosed furnace preferably. (b) It should be dipped into water. I have found in practice that the purer the water the better. It should be plunged into the water as rapidly as possible so that all parts are chilled at the same time. This will give it the proper degree of hardness without causing it to crack or shred, whereas if it is placed into the water slowly some parts become hard and some soft. It will naturally be harder at the ends than at the center if placed into the water slowly, which will cause it to shred. (c) It is

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proper to have a pair of magnetizing coils. These are nothing but a pair of large magnets mounted together, so that the fields are joined at one end. Of course, you could use a motor field and could obtain very good results. This could be used only for magnetizing a few. (d) It is not necessary that they be aged. (e) I regret that no book treats upon this subject thoroly, but this subject will be handled in the "Educational Course," which I would refer you to.

TELEPHONE IN RAILROAD SERVICE.

In a paper on "The Telephone in Railroad Service," read by Mr. F. P. Valentine before the recent Buffalo meeting of the Association of Railway Telegraph Superintendents, the remarkable development of the telephone in the operation of railroads was clearly set forth. It is estimated that today, in the United States, there are some two hundred private branch exchanges operated by the various railroad companies connecting over five thousand stations. Among the calls which are most numerous are those reserving places on trains, and information as to arrival and departure of trains. From a telephone point of view, it is declared that the Fall River line is the busiest in the country. As an illustration of what the public has to suffer from insufficient telephone facilities, it is declared that even with a branch exchange, having five trunk lines open to the public, with a telephone in the ticket office, with one man giving his entire time to the reservation of state-rooms, and with the switchboard operators relieving him of many calls by giving general information when reservations were not needed, the lines were still reported busy 1,600 times in one day. To remedy this it was found necessary for the line to double the number of trunk lines and sometimes two clerks were called in to help the clerks with his reservations. This, Mr. Valentine thought, was evidence of the great value of the telephone and showed how much labor was saved for the public even if persons were obliged to wait sometimes when others were on the same business. Mr. Valentine showed how useful the telephone was in freight offices by stating that in one of the largest freight yards in the country there is a completely equipped branch exchange in which three clerks are constantly employed to give information as to rates, shipment, or delivery. Many receivers of freight are notified by telephone at once of the arrival of goods, thus securing prompt removal of the freight and relieving congestion in the freight-houses. The telephone is useful, too, where there is competition between roads, for the agent can, by stepping to a telephone, communicate with headquarters and get his instructions, which frequently save freight from going to a competing road. On the contrary, insufficient telephone equipment may result in shippers communicating with a road that is well equipped in that respect, and the road which might have got the business may lose it. A telephone company noting that one railroad office telephone was constantly reported busy, kept a record with that of a line which had plenty of telephone service, and found that the former road had lost enough business to its competitor in one day to pay for the rental of a complete branch exchange equipment for a year. Other advantages pointed out by Mr. Valentine were the use of the telephone in the switch-towers and cabins so that all concerned in the handling of trains could be always within touch of each other, and the saving of time in switching had obviated delays to trains on the main lines, and the connection of all block-signal stations by telephone as well as telegraph so that in case of a wreck the division superintendent can keep in constant communication with the towers, and arrange for the passage of trains that otherwise might be stalled for some time under the old method of communication. In conclusion he said that the next few years would see some developments in the application of telephony to railroad service that would surprise some of those whose conservatism had led to the long delay in the appreciation of what seemed destined to become the chief means of communication of the future.

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ELECTRICAL UNITS.

Electrical units as recommended by the International Electrical Congress in August, 1893, and which have since been adopted and legalized by the United States, England and other countries. They are given as follows:

The unit of resistance, the international ohm, which is based upon the ohm equal to 10^9 units of resistance of the C. G. S. system of electro-magnetic units, is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grams in mass, of a constant cross-sectional area and of the length of 106.3 centimeters.

One B. A. unit =.9889 legal ohms = .9866 international ohms.

One legal ohm = 1.01122 B. A. units =.99767 international ohms.

One international ohm = 1.01358 B. A. units = 1.00233 legal ohms.

The megohm = 1,000,000 ohms.

The microhm = 1-1,000,000th ohm.

The unit of current, the international ampere, which is one-tenth of the unit of current of the C. G. S. system of electro-magnetic units, and which is represented sufficiently well for practical use by the unvarying current which, when passed thru a solution of nitrate of silver in water, and in accordance with the standard specification, deposits silver at the rate of 0.001118 grams per second.

Milliampere = 1-1000th ampere.

The unit of electromotive force, the international volt, which is the E. M. F. that, steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere, and which is represented sufficiently well for practical use by 1000-1434 of the E. M. F. between the poles or electrodes of the voltaic cell known as Clark's cell, at a temperature of 15° centigrade.

As a unit of quantity the international coulomb, which is the quantity of electricity transferred by a current of one international ampere in one second.

As a unit of capacity the international farad, which is the capacity of a condenser charged to a potential of one international volt by one international coulomb of electricity.

The microfarad = 1-1,000,000th of a farad.

As a unit of work the joule is 10^7 units of work in the C. G. S. system, and which is represented sufficiently well for practical use by the energy expended in one second by an international ampere in an international ohm. It is equal to .7373 foot-pound.

As a unit of power the watt, which is equal to 10^7 units of power in the C. G. S. system, and which is represented sufficiently well for practical use by the work done at the rate of one joule per second.

746 watts = one horse-power.

The kilowatt = 1,000 watts.

As a unit of induction the henry, which is the induction in the circuit when the E. M. F. induced in this circuit is one international volt, while the inducing current varies at the rate of one ampere per second.

One horse-power = 550 pounds raised one foot per second, or 33,000 pounds, one foot per minute = 746 watts.

Mils = thousandths of an inch.

d^2 = circular mils.

The circular mil is now generally used as the unit of area when considering the cross-section of electric conductors, the resistance being inversely, and weight of copper directly, proportional to the circular mils.

INDESTRUCTIBLE SOCKET FOR TELEPHONE POLES.

A German by the name of Carl Potsch is said to have secured patent No. 114,427 in Germany, for making an indestructible socket for telegraph poles, posts and other wooden appliances that have to be imbedded in the earth. It is said to be made of concrete, with a wooden sectional casing, which is fastened to the inserted pole with screws. The concrete envelopes the wooden casing. It is claimed that the invention not only protects the pole from the moisture and disintegrating chemicals of the earth, but that it gives great stability to it.

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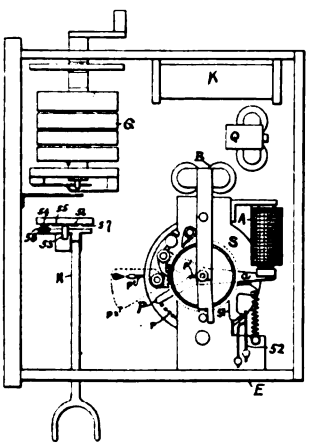
MONTHLY DIGEST OF TELEPHONE AND KINDRED PATENTS

EDITED BY CLARENCE C. BROWN.

Copies may be had, postage paid, by enclosing 5 cents for each one. Address inquiries in care of this magazine or Washington, D. C.

FRANK A. LUNDQUIST, CHICAGO, ILL.—SELECTOR SYSTEM FOR PARTY-LINES. No. 676,955. June 25, 1901. Assigned to the National Automatic Telephone Company.

In the illustration is a telephone box in which is contained a switch S provided with a pointer P and a series of contacts *p*, a magnet A operates the switch so as to move the pointer P step by step over the contact points *p*. This is engaged so as to show on a small glass indicator by the moving of a piece of cardboard behind it when the line is busy. The magnet A acting thru its armature lever *a* rotates a ratchet wheel.

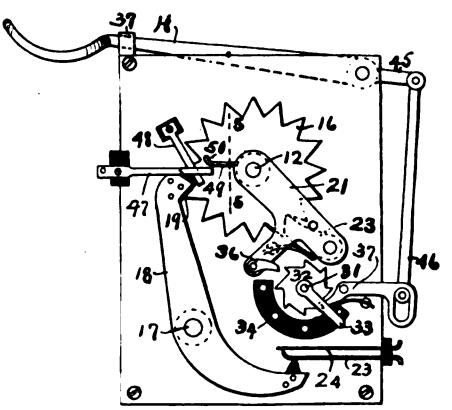


No. 676,955.

On the upper end of the splindle is an arm arranged to engage crown teeth on the ratchet wheel, so that the spindle and consequently the pointer P secured thereto will be turned when the magnet A operates. The armature lever for the magnet B engages a collar on the central spindle so that when the magnet B is energized it will lift the spindle and free the arm from the crown teeth of the ratchet wheel. When this occurs the spindle and its pointer P are returned to their normal position by means of a spring coiled around the central spindle. The receiver hook H has a T-shaped projection on it, and adjacent to this projection are the contact strips 53, 54, 55, 56 and 57. When the hook H is down the projection is in electrical connection with 53, and when it is up it is in electrical connection with 55, 56 and 57. When the hook is up 54 is in electrical connection with the contact point 24; but when the hook rises, a piece of insulation 58 on the said projection of hook H pushes away and breaks the connection between 24 and 54. In the box E are also a generator G, a ringer Q, and an induction coil K. At the central office there is a device which is arranged to send out impulses of current so as to work the step-by-step device and make the desired connection.

FRANK A. LUNDQUIST, CHICAGO, ILL.—CALLING DEVICE FOR AUTOMATIC SYSTEMS. No. 676,956. June 25, 1901. Assigned to the National Automatic Telephone Company, Chicago, Ill.

This is a calling device for automatic systems. A pointer movable by hand over the face of a numbered dial which



No. 676,956.

is arranged with a switch and a series of contacts so that when the pointer is

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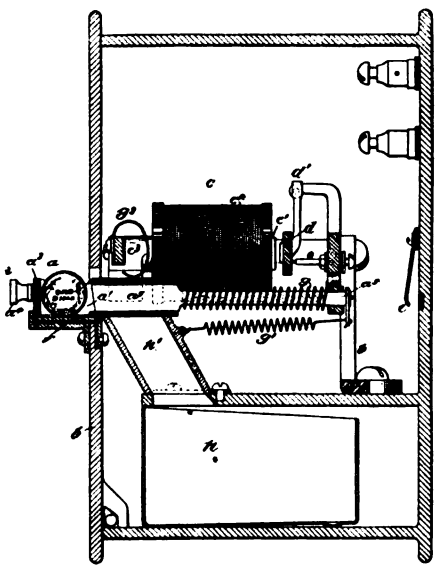
moved from its normal position it will mechanically shift the switch to a new position and is provided with a ratchet and pall so that the pointer will return at the normal position and in doing so make a series of electrical contacts which send electrical impulses over the line to the selector device. This device is arranged with a governor so that the afore-mentioned contacts are not made too rapidly. The diagram shows the appliance in detail.

CHARLES E. SCRIBNER, CHICAGO, ILL.—COIN COLLECTION FOR TOLL LINES. No. 677,807. July 2, 1901. Assigned to the Western Electric Company, Chicago.

This invention is intended to prevent toll boxes being worked by iron slugs. It is so arranged that the coin is deposited upon a projecting ledge. The

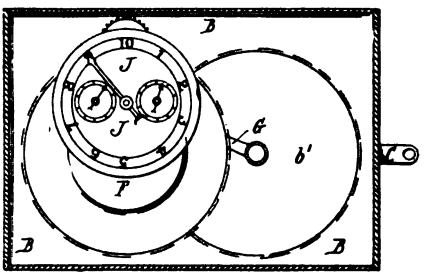


No. 677,807.

operator making the coin test energizes an electromagnet; if the slug is composed of metal of a magnetic nature it will be drawn inward by the energizing of the magnet; in doing so it will close the contact and transmit a signal to the operator, who will then request the subscriber to put some good money in the box, and refuse to give the party the connection until the same has been done. This will have the effect, as the inventor says in his specification, to have the tendency which the discovery of such an act has to discourage other attempts.

THOMAS BARET SYDNEY, NEW SOUTH WALES. TIME INDICATOR FOR TELEPHONES. No. 677,331. July 2, 1901.

This is a telephone meter system in which the service is charged according to the length of time the instrument is in actual use. It is devised so that a subscriber who has but little use for his telephone will not be compelled to pay the same as one whose instrument is



No. 677,331.

in constant use. To this end the lever-switch of the telephone is connected with the clock or other mechanism, which shall be inoperative when the telephone is not in use; but as soon as the receiver is lifted from the hook the clockwork shall commence to operate and will thus register the extent of time that the instrument is being used. The apparatus is so arranged that the up-and-down movement of the lever-switch shall wind up the clockwork and thus the operation will be almost entirely automatic. The drawing shows the dial upon which the time the telephone has been in use may be read.

WILLIAM D. GHARKY, PHILADELPHIA, PA.—TELEPHONE RECEIVER. No. 677,409. July 2, 1901.

This is a telephone receiver in which there is another method of adjustment. It is also arranged so that the strain upon the cords does not pull upon the conductors. Placed between the two magnets there is a pulley. The cord passes thru the shell of the receiver and is separated, one strand passing on one

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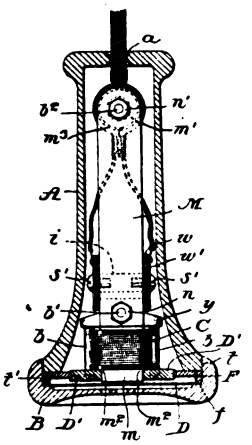
side of the pulley and the second on the other side. Both above and below the pulley the two strands are brought to-

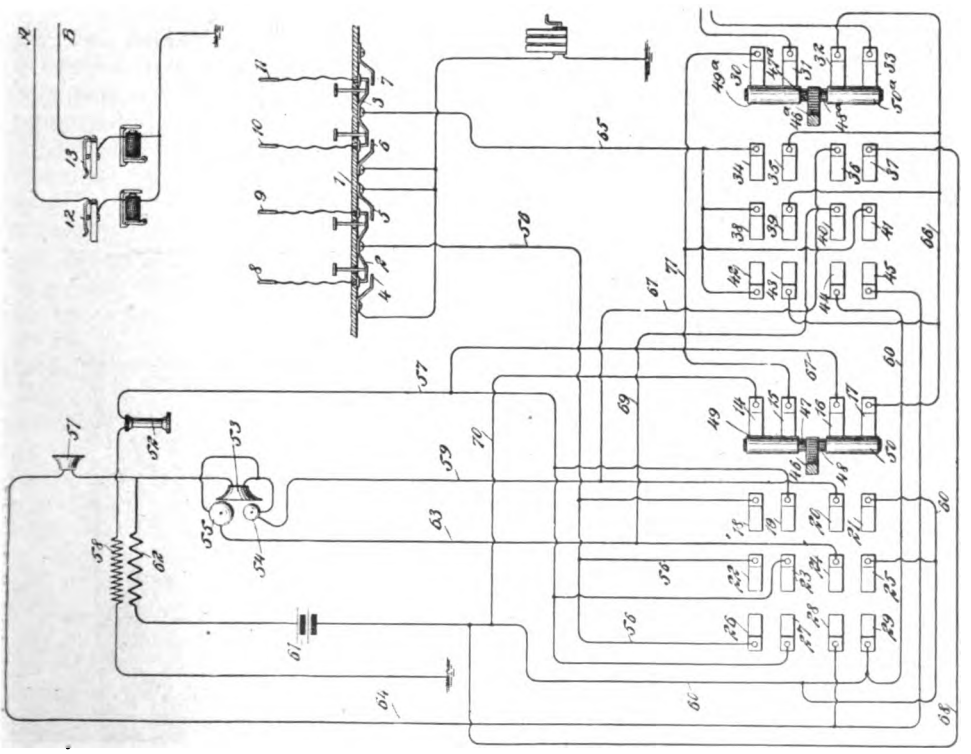


No. 677,409.

gether and wrapped, the entire strain now being upon the wrappings and the pulley. The entire magnetic structure of the receiver rests upon a collar which is supported between the diaphragm and the bobbins by the shell of the receiver proper. This is threaded so that it may be adjusted from this point. The illustration is a diagrammatic view of the receiver.

WILLIAM D. WATKINS, SAN JOSE, CAL.—AUTOMATIC SWITCH. No. 677,724. July 2, 1901. Assigned one-half to John W. Bolster, of the same place.

The object of this invention is to provide a simple and efficient construction which may be easily operated by depressing a simple form of push-button at central the proper number of times and wherein the predetermined subscriber's instrument will be cut into the line without cutting in any other instrument or instruments. A further object of the invention being to provide a construction wherein the 'phone battery may be utilized to energize the local circuit, including the electromechanical portions of the apparatus. The diagram shows a complete instrument connected.



No. 678,304.

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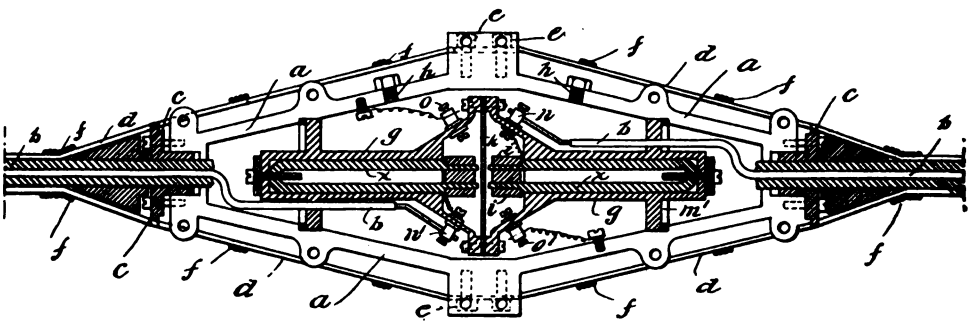
JACQUES NESSEL AND JEAN FREDERIC GOUIN, BREST, FRANCE.—LONG-DISTANCE RELAY MAGNETIC TELEPHONE. No. 678,509. July 16, 1901.

This invention consists of a hermetically closed inner non-magnetic casing, together with the energizing magnets which are enclosed with the diaphragm. The casing is provided with earth terminals to which the bobbins of the magnets are connected. Conductors extend from the outer casing so that the connections may be made. The cable B enters the relay and is connected to the bobbins by means of the terminals *n n*. From the bobbins the cable is connected to earth by means of the terminals *o-o* and the outer casing *a* of the relay. This instrument consists of three essential parts, that is to say, that body of the casing *a* of cast metal constructed preferably of torpedo shape and consisting of four parts united by bolts. The cable *b* passes in at each extremity of the apparatus thru a hermetic joint *c*. The wires *d* of the armor of the cable—if this latter is a coast or medium-size cable — leave the cable where it enters the relay and are united upon the circumference of the double cone body or casing *a* in such a manner as to be firmly fixed beneath the screws *e*, which are arranged for this purpose upon the opposite cone. Above these wires and around the circumference of the body of the apparatus a ligature *f* is formed at intervals in such a manner as to constitute a rigid whole and obviate all likelihood of rupture. In the case-metal casing two apertures *h* are formed to admit of the passage of the melted paraffin which is used to fill the spaces between the two casings and thus insure perfect insulation. The apparatus may be employed for the purpose of connecting two overhead lines.



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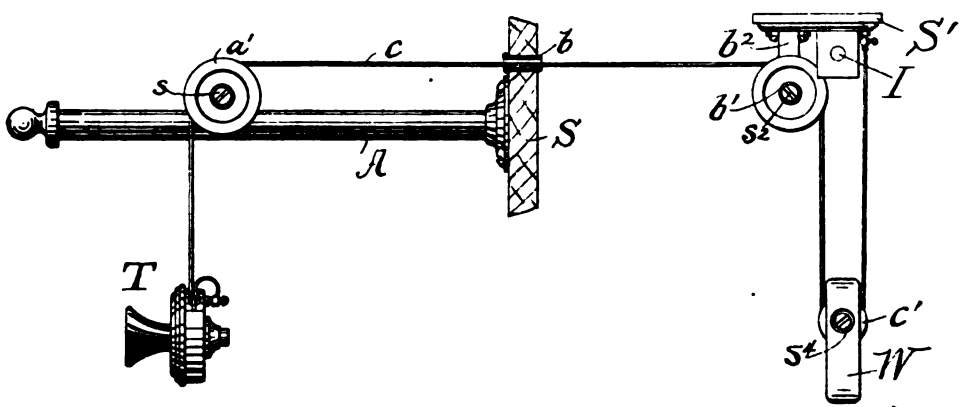

No. 677,410.

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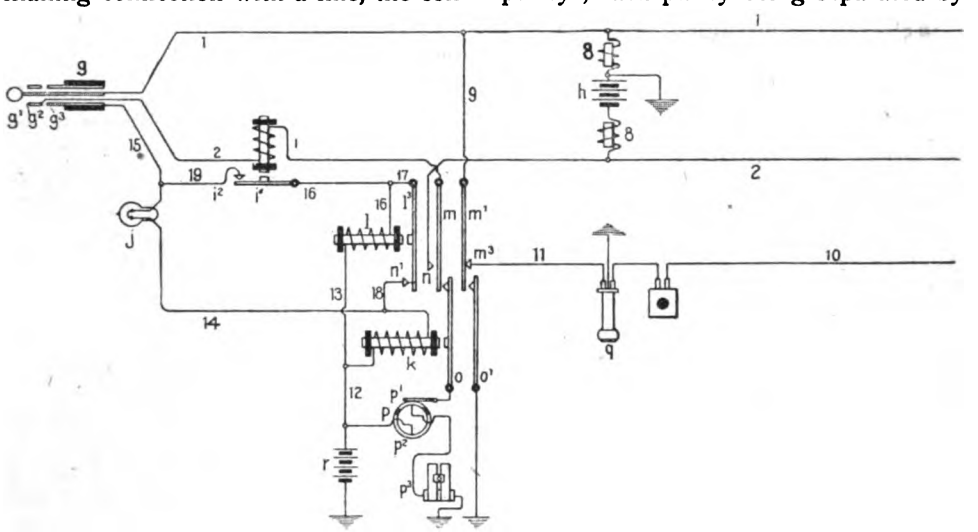
MR. FRANK R. MCBERTY, DOWNERS GROVE, ILL.— CALLING APPARATUS FOR TELEPHONE SWITCHBOARDS. No. 678,369. July 16, 1901. Assigned to Western Electric Company, Chicago.

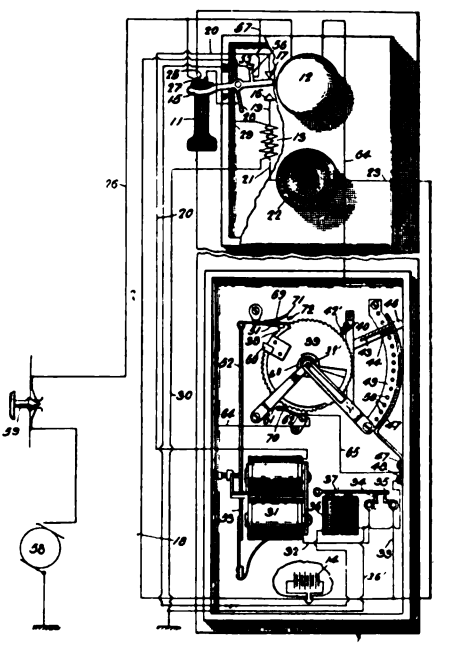
This invention is for the automatic application of a source of calling current to a telephone line in the act of making connection with a line, the control of the circuit to the operator's telephone involved in testing lines, and the operation of signals associated with the line with which the connection is made. Its several objects are to cause the act of making connection to a line in response to a call from a different line, to determine the transmission of a calling current when the called subscriber answers; to disconnect the operator's telephone from the plug circuit when connection is made with the line, the telephone having been normally in connection with the line for testing purposes; to associate with the line a supervisory signal responsive to currents in the line determined by the position of the telephone at the substation, but to efface this signal during the transmission of calling current permitting its free operation only in a subsequent stage of the connection, and to associate the various agencies for accomplishing these ends with the circuits and appliances. The diagram shows this system in connection.



No. 678,369.

WILLIAM D. GHARKY, PHILADELPHIA, PA.— OPERATOR'S SUSPENSION SET FOR TELEPHONE SWITCHBOARDS. No. 677,410. July 2, 1901.

This is a method of suspending switchboard transmitters on two bare conductors; these conductors are insulated from each other by passing over pulleys, each pulley being separated by



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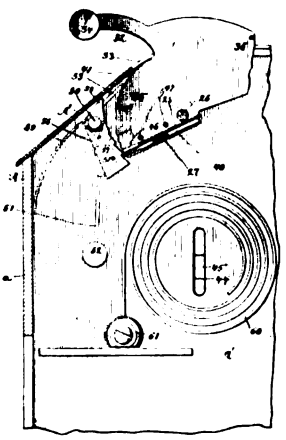
being imbedded in a non-conducting material. The object of the invention is that it will not obstruct the view of the operator of the switchboard, as the two bare strands will be thin enough to allow the operator to see every part of the board. The drawing shows the apparatus completely assembled.

EDWARD P. BAIRD, EVANSTON, ILL.—TOLL APPARATUS FOR TELEPHONES. No. 678,632. July 16, 1901. Assigned to the Baird Manufacturing Company, Chicago, Ill.

This is a toll collection box adapted to receive coins of three denominations, in which the claims lay in the following: The combination of a case together with a carrier whereby a deposited coin will be shifted into a proper receptacle;



No. 678,632.

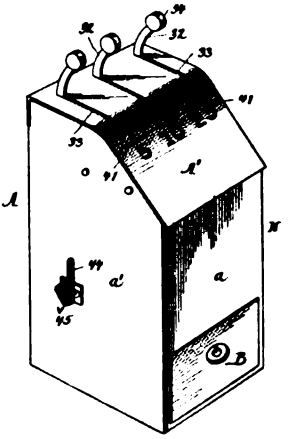
in doing so it will strike a lever for actuating a signal as the coin is released and it passes into its receptacle. The illustration shows a section of this device.

WILLIAM EDWIN PEMBLETON, WITTENBERG, WIS.—TELEPHONE CIRCUIT. No. 678,304. July 9, 1901.

In this device a connection is made upon the ringing and listening key so that when the party calling is thrown in talking connection with the operator it rings a bell. This notifies the subscriber that the operator is then ready for his order. After the operator makes the connection and rings the called party a bell of a different tone is sounded, thus doing away with the operator speaking with the subscriber at all. The illustration shows the device in connection with the switchboard.

EDWARD P. BAIRD, EVANSTON, ILL.—TELEPHONE TOLL APPARATUS. No. 678,633. July 16, 1901. Assigned to the Baird Manufacturing Company, Chicago, Ill.

The object of this invention is to provide an improved signal device to provide a muffler for a sound-yielding body which prevents extended vibration of said body to avoid confusion of the



No. 678,633.

audible signals when given in rapid succession, to provide a positively operated ejector for removing the coins or tokens from the carrier after the signal device has been actuated. The diagram shows a full view of this device.

A FUSIBLE ALLOY.

To those who delight to experiment, the following formula will be of value: In experimenting with heat-coils or any other form of lightning arrester, it is to an advantage to use a metal that will melt at an exceedingly low temperature, and an alloy consisting of the following will melt in hot water: Lead 3 parts, tin 2 parts, bismuth 5 parts; these should all be melted together in a crucible by the aid of a gas or gasoline furnace, and after they are melted together may be cooled and then the alloy will be found soft enough to melt in hot water.

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A DECISION ON THE RIGHT OF AN INDIVIDUAL TO USE A TELEPHONE EXTENSION.

A decision was last week handed down by the Appellate Division of the Supreme Court of Rhode Island in the case of Dr. Clarence T. Gardner against the Providence Telephone Company, in which the petitioner asked the court to grant an injunction preventing the telephone company from carrying into execution its intent to deprive him of telephone service at his house and office because he used extension sets not furnished by the company. The opinion of the court, which is rendered thru Mr. Justice Douglas, is that the request for an injunction must be refused. To this opinion Mr. Chief Justice Stiness has filed a dissenting opinion. In Dr. Gardner's bill in equity he set forth that he was and for many years had been a customer of the telephone company, renting a telephone instrument both at his office and his residence; that he had paid and was willing to pay all rentals and had used and was willing to use the telephone in accordance with all reasonable rules and regulations; that he is a physician in active practice, that a large proportion of the calls for his services are received over the telephone, and that deprivation of that service would be detrimental to his practice. February 23, 1897, the bill says, the company notified the plaintiff that at the expiration of one month from date it would cut off his telephone service, refuse to answer his calls and to connect him with other subscribers.

The answer of the company denied that the plaintiff had used his telephone properly and complied with reasonable rules and regulations of the company. The regulation he had violated is that which provides that no telephone or telephonic instrument shall be used by any customer except such as may be furnished by the company. The company said that it furnished extension sets, so-called, as a valuable part of its business; that such extension sets consist of a second telephone and transmitter connected by wire with the original telephone and transmitter placed in the subscriber's premises, the second set being in another part of the premises, and that the plaintiff in violation of such rule (claimed by the company to be reasonable) has installed both in his office and his residence an extension set not furnished by the defendant. The company admitted that by reason of the alleged violation of a regulation of the defendant it did threaten to deprive the plaintiff of telephone service and would have done so had not the bill in equity been filed, and claimed that it had the legal and equitable right to do so. The company averred that by attaching the wires connecting his extension set Dr. Gardner trespassed upon the company's property; that the wires of the extension set are hidden and the company's property is endangered by the possible presence of strong currents coming over such wires, and the company is made liable for the destruction thereby of other property and injury to persons. Testimony was also introduced to show that the use by a subscriber of a private extension set is liable to interfere with the working of the company's system.

The extension sets Dr. Gardner has used were bought in 1896 for $50 each, and the same thing can now be bought for $12.50. Testimony set forth that there was no attempt to conceal them from the defendant, and it was claimed that the wires connecting them are at all times in plain sight, and the attention of the defendant's agents has been called to them whenever they visited the doctor's premises. The prohibition against the use of extension sets other than those furnished by the company was issued in 1896 or 1897, and subscribers who had attached them were notified that the telephone company forbade their use, and were required to remove them.

"The question which arises for the decision of the court," says the opinion, "is whether a corporation having a monopoly of the telephone business in a community can deprive a subscriber of telephone service for the reason that he refuses to discontinue the use, in connection with the wires of the company

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on the subscriber's premises, of an extension set not furnished by the company.

"The general principles of law upon which the complainant relies are well settled. The telephone company has rights granted by the city, in pursuance of legislative authority, to make certain uses of the highways of the city, and no other company has similar rights. By municipal action, therefore, invoked by the defendant, the complainant is forced to deal with the defendant if he desires telephonic service. Undoubtedly it is a condition of such a grant that the grantee shall furnish to such of the public as desire it complete service of the kind in which it deals, with such appliances for use and convenience as the state of the art affords from time to time. And it can not be disputed that the company may impose such reasonable rules for the use of its appliances as are required to insure efficiency and safety, and that no unreasonable rule or requirement can be enforced as a condition of furnishing equal service to the whole public. The service which a telephone company undertakes to render, and which it receives special privileges from the public that it may render, is analogous to that of a common carrier, and its obligations to the public are to be determined upon the same principles which have long been settled with reference to persons or corporations engaged in business which required special public concessions. The general principle is laid down in Mumm *vs.* Illinois, 94 U. S., 113."

Here various authorities are quoted, after which the opinion proceeds: "The defendant does not argue against these general propositions of law, but insists that it is reasonable for it to claim the right to furnish and control the whole telephonic plant on the premises of a subscriber which shall be connected with its lines.

"We can not assent to all the reasoning of the defendant's counsel in support of this proposition. We are inclined to believe his apprehension of danger from other electric conductors on the subscriber's premises is exaggerated. The fact that the company has submitted to a modus vivendi with the complainant since it first knew of his use of an extension set which has continued the attachment till the present time without any serious accident indicates that in this instance safety is not a controlling consideration. And we can not agree that any slight modification by the subscriber of the use of the instrument placed in his house, as e. g., by the attachment of a funnel for magnifying sound, would constitute a trespass on the property of the company in the technical meaning of the word.

"Neither does it appear that the addition of an extension set to a customer's circuit increases the labor of the operator at the switchboard. So long as the subscriber is entitled to the use of the line as often as his business requires, and but one person can use the line at a time, either thru the main telephone or the extension set, there can be no more calls sent in than the rates already established have contemplated. Indeed, the saving of time to the central office by reason of the superior accessibility of the customer who has an extension set nearer than the telephone is an advantage to the company.

"But we do believe that the claim finds justification and support in the nature of the service and the agencies employed in it. The telephone circuit includes delicate instruments actuated by currents of electricity of feeble power. The introduction into a set of extension sets requires mechanical skill to secure perfect adaptation to the original circuit and its appliances. It seems plain to us that this should be the work of the same party which builds and operates the original circuit to the same routine of inspection. The original circuit and additions to it should be a unit in construction, operation and management. The circulation of the electric current by which the telephone is operated differs essentially from the distribution of illuminating gas, tho both are supplied from a central source and used upon the premises of a customer. The gas which is supplied thru a meter is forever beyond any control of the producer; no use that the cus-

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tomer makes of it can react so as to affect the company or its distributing system. Whether a cubic foot of gas is used for light by means of one burner or another, for heating by one system of stove or furnace or another, can make no possible difference to the manufacturer, and hence it would be unreasonable for a gas company to insist upon supplying stoves or burners or to dictate in what position on the premises the gas should be finally consumed. An electric current, on the contrary, does not terminate in but passes thru the customer's premises. The circuit must be complete either wholly along a metallic conductor or partly thru the earth. The current while passing from as well as to the premises of the customer exerts its natural influence upon conductors and resistances which it encounters. Any appliance introduced anywhere to modify the action of the current may produce results at any other point in the circuit. When the telephone is in use the subscriber's circuit is connected with that which includes his correspondent and in practice may be connected with one circuit after another thruout the whole system. A company, therefore, furnishing the use of an electric current generated by its own apparatus may reasonably require that it shall not be diverted over other channels and used to actuate other appliances with which the company is not familiar and which have not received its approval.

"Now, the best adaptation of an extension set to the system to which it is added, and the best supervision of such a set and system, and the best service to a customer, may reasonably be expected when the whole system and its extensions are installed and controlled by the company. It is, therefore, reasonable that the company should insist upon the right to furnish extension sets when they are desired, or in the alternative to refuse to give or continue its service.

"But this right is contingent and not absolute. It is subject to the obligation we have alluded to above, viz., that the company shall be able and willing to furnish extension sets as efficient and convenient as that state of the art affords. It is the duty of the company to keep abreast of the march of improvement, so as to serve its customers as conveniently as they can provide for themselves from the market. Such improvements and extensions as are offered must not be accompanied with extortionate demands for compensation so as to render the offer nugatory. The price charged for the extra accommodation must bear some relation to the actual cost of it, and the additional burden of care and maintenance.

"While the Court exercises no supervision over the prices fixed by a telephone company generally, it must consider the amount charged for the performance of a duty to a customer in deciding upon the reasonableness in any particular case of requiring the customer to seek such service exclusively of the company. So long as the company observes these equitable principles in acting under its rule, the Court will consider its action reasonable and will sustain it. If, however, the company neglects its duty to the public and is not provided with the means to secure the accommodation of its customers, or having at command such appliances, refusing to furnish them except at exorbitant rates, we can not question the right of the customer to supplement the imperfect service of the company with improved appliances procured elsewhere, provided that such appliances can be used in connection with the company's circuits without detriment to their harmonious operation. We think, however, that before a customer is justified in such an invasion of the prima facie rights of the company he must apply to the company to furnish the additional accommodation desired, and if the company refuses or couples its consent with unreasonable conditions, he must be prepared to show affirmatively that the appliance which he annexes to the company's system is not injurious to the system or its operation before he can have the assistance of a court of equity to compel the company to include his device in their service.

"The complainant does not bring

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himself within these limitations. He began by annexing to the defendant's circuit an apparatus of his own selection without first requesting the company to furnish him with an extension set or asking their terms for such extension of their service. In regard to the set which he uses he has not made it clear that it is suitable for use with the grounded circuit which he hires of the company. The company itself does not use this apparatus in connection with grounded circuits. It is plain that the complainant has no right to insist upon a particular form of apparatus if the company is ready to furnish one which will substantially accomplish the same purpose and which is adapted to the circuit they may operate. It does not appear from any evidence in the case that they have not been and are not now ready and willing to do this for a reasonable compensation. On the contrary, they say they are willing and offer to do so. In these circumstances the injunction must be refused."

In his dissenting opinion Mr. Chief Justice Stiness holds that the injunction should be granted. He says:

"Agreeing with the general statements of law in the foregoing opinion, I am unable to agree with its conclusion, which to my mind is inconsistent with it.

"Having said that the defendant's proposition that it should have the right to furnish and control the whole telephonic plant on the premises of a subscriber can not be assented to in full, and further, 'that such improvements as are offered must not be accompanied with extortionate demands for compensation so as to render the offer nugatory,' and that 'if, however, the company neglects its duty to the public and is not provided with means to secure the accommodation of its customer, or having at its command such appliances refuses to furnish them except at exorbitant rates, we can not question the right of the customer to supplement the imperfect service of the company by improved appliances procured elsewhere, provided that such appliances can be used in connection with the company's circuits without detriment to their harmonious operation,' the logical result from the facts in this case is a decree for the complainant.

"The opinion asserts the right of a subscriber to supplement the service of the company under two conditions, both of which appear in this case:

"First. If the company demands exorbitant rates.

"The complainant now receives satisfactory service for $82 per year, and the company demands $220 for the same service. The extension instrument costs $12.50 at retail, and the company charges $18 per year for the use of it, at least 150 per cent of its cost. The additional charge is made for metallic circuit, which is neither shown to be necessary nor of advantage to the subscriber or to the company except in the matter of income to the company. Under those circumstances the company's demand is manifestly exorbitant.

"Second. No detriment to the company is shown by the complainant's use of the extension set, either in its demand upon service or in safety.

"On the contrary, the opinion is in favor of the complainant on both of these grounds.

"I am, therefore, unable to see any sufficient reason for refusing the complainant prayer for an injunction."

The case was argued April 10 last. Messrs. Comstock and Gardner represented the complainant; Dexter B. Porter and David S. Baker the respondent.

KILLED AT THE 'PHONE.

An interesting and somewhat unique case, involving the use of lightning arresters on telephone lines, has recently been decided by the Supreme Court of Vermont. A physician, while sitting in his library near a telephone instrument, was instantly killed by an electrical discharge from the wire, and the plaintiff contended that in not having provided a suitable apparatus or appliance to conduct the lightning to the earth, or at least out of the house, the telephone company was guilty of culpable negligence. In the lower court judgment was rendered in favor of the heirs of the physician, and the Supreme Court, to which the case was appealed, affirmed the decision.

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TELEPHONE NEWS.

ARKANSAS.

CAMDEN, ARK.—A telephone line from Camden to Woodberry, Calhoun county, is now under construction. Mr. W. F. McKnight, of Woodberry, is the promoter and builder of the line.

CHARLESTON, ARK.—Articles of incorporation of the Franklin County Telephone Company were last week filed with the Secretary of State. The place of business is at Charleston. The capital stock is $2,000. The officers are K. E. Hudson, president; Joe Yunker, vice-president; J. S. Smith, secretary; S. P. Gammill, treasurer.

DUMARS, ARK.—Arkansas River Telephone Company, capital stock, $6,000.

OZARK, ARK.—A recently chartered company is preparing to construct a telephone line from Charleston to Ozark, Ark.

ARIZONA.

TOMBSTONE, ARIZ.—The city council will consider the matter of granting a franchise for a telephone system in Tombstone. The application is made thru Mr. E. J. Ijams, of Safford, who contemplates extending their line thru Pearce, Gleason, Tombstone and Bisbee and ultimately to Tucson.

DAKOTAS.

BISMARCK, N. D.—E. S. Allen, of Bismarck, N. D., has bought materials for an exchange there. He will use the Stromberg-Carlson instruments and a central-energy board.

FORMAN, N. D.—The Forman Telephone Company will extend its line from Forman to Hankinson.

GRAND FORKS, N. D.—The Northwestern Telephone Exchange Company announces that it will expend $25,000 in Grand Forks, N. D., in the erection of a new exchange, placing wires underground in business districts and general improvements.

ALEXANDRIA, S. D.—Wayne and Beulah Township Telephone Company, at Alexandria, with a capital stock of $5,000. Incorporators: M. J. Hicks, Henry Montgomery, J. W. Love, F. W. Allen, T. H. Quanney and George A. Dean.

WEBSTER, S. D.—Webster Telephone Company has installed an exchange in Webster. They have one hundred subscribers and are building thirty-five miles of toll line.

FLORIDA.

ARCADIA, FLA.—Letters patent have been granted for the incorporation of the Arcadia Electric Light, Ice & Telephone Company, with a capital stock of $20,000, to establish and maintain a general electric light business in the city of Arcadia, a plant to manufacture ice and establish and operate a telephone system in said city, and such other places in the State as the directors may deem expedient.

BARTOW, FLA.—G. S. Van Buskirk, representing the Peninsular Telephone Company, is at Bartow in the interest of his company. He has a list of sixty subscribers, and will begin the erection of the exchange at once. The franchise granted this company provides that if Bartow is not connected with Tampa within eight months and Jacksonville in two years from date of franchise, the company will forfeit $1,000, which amount they are to deposit with the city before beginning work. Mr. Van Buskirk says they will begin work in Bartow not later than August 1, so it is an assured fact that Bartow will be connected with Tampa, and probably Jacksonville, early this fall.

STARKE, FLA.—M. G. Rowe, who has a franchise for putting in a telephone exchange, is rapidly pushing the work, and will have the system in order soon.

TAMPA, FLA.—W. G. Brarien, James L. Langford, James W. Barrick and Guy Huffman have incorporated the Peninsular Telephone Company at Tampa, Fla., with a capital stock of $300,000.

GEORGIA.

LOVEJOY, GA.—The Clipper Construction Company, C. M. Curtis, business manager, has been granted a franchise to put up a telephone line from Atlanta to the county line. This company makes a specialty of rural telephones, and it is said that it proposes to have lines from Jonesboro, Lithonia, College Park and other points in the vicinity of Atlanta. The system will connect with the Standard system in Atlanta.

ROME, GA.—A telephone system will be constructed from Chattanooga, Tenn., to Rome, Ga., by the American Telephone Company.

ILLINOIS.

ATLANTA, ILL.—Palmer-Darnall Company have bought the Dr. Burke telephone system at Atlanta, and will begin at once to rebuild the lines, which now represent 225 'phones and more will be added. The company has already installed a new exchange with 35 'phones at Armington, and a new $500 switchboard and metallic base at Atlanta.

AURORA, ILL.—The Northwestern Illinois Telephone Company, with a capital stock of $500,000, operating telephone exchanges in Aurora, Joliet, Plainfield, Elgin, Dundee, Batavia, Geneva, St. Charles, Sugar Grove and Kaneville and all farming towns of Kane county, at a recent meeting of stockholders and directors elected Senator H. H. Evans, of Aurora, president.

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BLUFFS, ILL.— Illinois Telephone Company, of Bluffs, Ill., has increased its capital stock from $25,000 to $100,000.

CHAMPAIGN, ILL.—The Home Telephone Company has ordered another carload of poles and several tons of wire. The company will put nearly $1,000 more into the business, which makes a total investment of about $4,000.

CHARLESTON, ILL.—The Charleston Telephone Company is remodeling and rebuilding its plant, doubling its cable facilities and putting in an entire exchange equipment of the Sterling Electric Company's switchboards and protective devices.

CHARLESTON, ILL.—The Farmers' Mutual Telephone Company now has over two hundred subscribers, divided into nine sections. The towns reached are Casey, Westfield, Martinsville, Janesville, Union Center, Trilla, Oil Field, Salisbury, Diona and Lerna. A charge of 10 cents a call is made. Manager Lafferty, of Casey, will make Charleston his headquarters hereafter. He printed a card large enough for 400 names, and expects to have 500 subscribers within the next six months. The system is expanding every day, and soon every farmer within a radius of twenty-five miles will be connected.

CHICAGO, ILL.—The Country Home Telephone Company, located at Chicago, has a capital stock of $100,000; object, manufacturing electrical inventions. The incorporators are Albert A. Paterson, Edwin T. Munger and others.

CHICAGO, ILL.— Metropolitan Telephone & Electric Company, Chicago: capital stock, $10,000; manufacturing mercantile construction and operating business; incorporators, Max W. Zabel, O. M. Leich, H. L. Hanson.

DIXON, ILL.—The Lee County Telephone Company now has in operation at the Assembly a Kellogg slot machine which receives nickels, dimes and quarters, automatically ringing the telephone bell and making connections. To test the machine, pennies were placed in the slots, but the machine refused to accept them, throwing them out of a slot at one side. A Canadian dime was also tried, but the machine threw it out.

ELLSVILLE, ILL.—The Jackson County Telephone Company is incorporated, with a capital stock of $2,450; object, to operate a telephone system. The incorporators are Chester Schwartz, G. D. Hays and C. M. Thornton.

FOREST CITY, ILL.— Forest City Telephone Company has been incorporated, with capital stock of $10,000, by J. N. Moore, C. R. Simmons, W. W. Pool, D. E. Young and others.

GALESBURG, ILL.—The Union Telephone Company, recently organized, has elected the following directors: Howard Knowles, P. F. Brown, Nels Burgland, P. N. Granville, Ira Callender, W. E. Terry, L. Weinberg, W. A. Olson, H. M. Chase, H. Sauter and G. B. Churchill. The company is capitalized at $100,000, and $90,000 will be spent in the construction of the plant.

GIBSON CITY, ILL.— Gibson Telephone Company, Gibson City; capital stock, $12,000. Incorporators, George F. Schlosser, A. L. Phillips and H. A. Ball.

LA SALLE, ILL.— Since February 1 of this year the Central Union Telephone Company has been operating in La Salle without a franchise, it having expired on that date. No efforts were made on the part of the company to have its franchise extended. At the last meeting of the council the matter was brought before that body by the city attorney, and notice will at once be served on the telephone company to remove the poles and other paraphernalia from the streets in thirty days.

MATTOON, ILL.—The $75,000 fire at Mattoon, Ill., July 3, entirely destroyed the central office of the Mattoon Telephone Company, as well as considerable of aerial cable. Dr. Lumpkins, the president, has arranged with the Sterling Electric Company for a temporary apparatus so as to enable it to give service, and inside of sixty days will have built a new fireproof building and one of the most modern telephone buildings in the State of Illinois. Its entire equipment will be the well-known make of the Sterling Electric Company.

MAGNOLIA, ILL.— Magnolia Mutual Telephone Company, Magnolia; capital stock, $2,500; incorporators, Perry Dakin, E. E. Barbour and John Davidson.

MCNABB, ILL.— McNabb Mutual Telephone Company; capital stock, $2,500; telephone system; incorporators, J. N. Wilson, W. L. Mills, Vivian Haws.

PLEASANT PLAINS, ILL.—The Boynton Telephone Company, of Pleasant Plains, was licensed to incorporate by Secretary of State Rose. The company is to operate a telephone system in the village of Pleasant Plains and vicinity. Its incorporators are E. D. Boynton, J. M. Howard and O. E. Ferry.

RUTLAND, ILL.— La Salle and Marshall County Telephone Company, Rutland; capital stock increased from $5,000 to $10,000.

STREATOR, ILL.—The new Streator Independent Telephone Company now has connection with the following places and is prepared to give good service at a very reduced rate: Ancona, Dana, El Paso, Garfield, Hudson, Kangley, Kappa, Leeds, La Rose, Lostant, Minonk, Rutland, Toluca, Wenona, Woodford, and will connect with Bloomington and all the smaller places in that vicinity. They have added over fifty new subscribers since they started operation July 1.

WARRENSBURG, ILL.—The articles of incorporation of the Warrensburg Telephone Company have been filed. The company already has a number of 'phones in working order. The list of stockholders comprises seventy names. The capital stock of the corporation is $5,000. The directors of the new company are G. D. Randolph, F. W. Lehn, J. T. Tucker and C. C. H. Cowen.

IOWA.

ACKLEY, IOWA.—The Cedar Valley Tele-Telephone Company will install a local ex-

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change for Ackley as rapidly as possible. It will be an automatic exchange.

ADAIR, IOWA—Adair Telephone Company; capital stock, $10,000; incorporators, L. H. Paine and others.

ALDEN, IOWA—By the Mutual Telephone Company of Alden; capital stock, $3,000; T. H. Pletsch and others are incorporators.

CEDAR RAPIDS, IOWA—The United Telephone & Telegraph Company, incorporated by A. T. Averill, W. H. Dunn and G. M. Averill, of Cedar Rapids, Iowa, and Charles Webster and G. W. Patler, of Waucoma, Iowa, has filed its articles in Hennepin county. The capital stock is $100,000. It is understood the new company will take over the property and franchise of the Greene & Western Company and coöperate with the Twin City Telephone Company. The Greene & Western lines run from St. Paul to Mankato and from Minneapolis to Waterville.

CEDAR RAPIDS, IOWA—If the city council of Cedar Rapids passes the ordinance drawn by the Iowa Telephone Company, that corporation will expend $100,000 in improvements principally in the laying of underground conduits for all wires in the business part of the city.

COON RAPIDS, IOWA—A. Dixon has been granted a franchise for a telephone exchange for Coon Rapids.

COLFAX, IOWA—It is reported that the Jasper County Telephone Company has purchased the old Iowa exchange in Colfax and will begin at once to make important improvements in the telephone service in that city. Both long-distance and local service will be maintained.

DES MOINES, IOWA—The Hopkington Telephone Company filed an amendment to its articles, increasing the capital stock from $3,000 to $10,000.

DES MOINES, IOWA—The Iowa Collection & Trust Company, of Des Moines, filed articles of incorporation recently with the Secretary of State; capital stock, $10,000; incorporators, Ira W. and A. L. Anderson.

DES MOINES, IOWA—Articles were filed by the Mechanicsville Telephone Company. The capital stock is $3,500. George W. Fall is president, Charles E. Gould, secretary, and J. H. Onstot, treasurer.

MASON CITY, IOWA—The Greene & Western Telephone Company will make extensive improvements to the exchange at Mason City, Iowa. A new switchboard will be installed and other changes made.

MADRID, IOWA—The People's Telephone Company, of Madrid, Iowa, has filed articles of incorporation, with capital stock of $10,000. The incorporators are T. R. Dresser, J. G. Kenison, F. A. Anderson, W. T. Roberts, S. L. Miles and John Sandburg.

MAXWELL, IOWA—The Maxwell Telephone Company, of Maxwell, Iowa, has been incorporated, with $5,000 capital stock.

ROCKWELL CITY, IOWA—The Central Telephone Company, of Rockwell City, has filed articles of incorporation with the Secretary of State. Its capital stock is $50,000. J. Bradt and P. C. Holdoegel are the incorporators.

STUART, IOWA—The Hawkeye Telephone Company will extend a toll line from Greenfield to Stuart, Iowa, and will make improvements to the exchange at the latter place.

SIOUX FALLS, IOWA—The Faulkton Telephone Exchange has been sold to Fremont Young and J. H. Hayes, of that place.

VINTON, IOWA—Lightning struck the switchboard in the Iowa Telephone Exchange here and completely destroyed it. The loss is about $1,000.

INDIANA.

CLERMONT, IND.—Clermont Telephone Company, Clermont. Capital stock, $10,000. Directors: Benjamin F. Long, A. N. Miller, J. M. Carter, A. V. Hightshue, Charles T. Burgoyne, A. O. Rusie and A. J. Jones.

ELKHART, IND.—The Farmers' Mutual Telephone Company has a capital stock of $5,000.

JERICHO, IND.—The Advance Telephone Company has been incorporated, with a capital stock of $1,000.

LAFAYETTE, IND.—Daniel E. Storms, receiver for the Shawnee Mound Telephone Company, acting under the instruction of Judge Vinton, sold the property of the company to Samuel B. Lutz. The price paid was $3,500.

LAFAYETTE, IND.—Lafayette capital, to the amount of $250,000, has taken all the stock for an independent telephone system to be established at Evansville. All the stock is paid up and the work of installing the new system is to begin about August 1. The work is to be pushed rapidly to completion. The franchise was obtained February 1, 1896, and has a fifty years' existence. Twelve men have taken all the stock.

LAFAYETTE, IND.—The Mutual Independent Telephone Association of Indiana elected the following officers for the ensuing year: President, L. A. Frazee, Connorsville; vice-president, C. A. Zion, Lebanon; secretary-treasurer, H. B. Gates, Indianapolis.

LAPORTE, IND.—The Laporte Telephone Company has increased its capital stock to $20,000.

LYNN, IND.—The Lynn Local Telephone Company; capital stock, $2,400; directors, W. E. Hinshaw, J. S. Blair, Daniel Hecker and William Halliday.

PERU, IND.—Peru Home Telephone Company, Peru; capital stock, $30,000; directors, C. J. S. Kumler, J. M. Bergeman, Jerome Herff, E. H. Griswold, John E. Yarling, James Andrews, L. B. Fulwiler.

SHANNONDALE, IND.—The Shannondale Coöperative Telephone Company; capital stock, $600.

TERRE HAUTE, IND.—Terre Haute Electric Company has been incorporated, with a capital stock of $1,000,000.

WABASH, IND.—Serious damage was done to the telephone system by the recent storm. The services of the Home Telephone Company were practically suspended for a time.

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At Portland, in an adjoining county, the storm caused the United Telephone Company severe loss in instruments.

WABASH, IND.—Jerome Herff's new independent telephone company is an assured fact. The company is capitalized at $30,000, and Lon B. Fulwell is president and Mr. Herff vice-president.

WEST NEWTON, IND.—The West Newton Telephone Company was organized, with A. M. Newsom, president; J. M. Mendenhall, secretary-treasurer, and J. M. Horton, Dr. Bart Ratcliff and D. C. Morgan directors. Capital stock, $10,000. Operations will be conducted thru the New Telephone Company.

KENTUCKY.

COVINGTON, KY.—At a meeting of Covington Council, an ordinance was passed granting the City & Suburban Telegraph Company a twenty-year franchise for the building of underground conduits for telephone and telegraph wires. The considerations are $100 in cash, the free use by the city of five telephones, and the use of one duct for the placing of the city's fire and police alarm wires. A bond of $50,000 and the contract itself were offered and accepted.

GLASGOW, KY.—Chartered: Boone County Telephone Company, with capital stock of $3,000, by J. M. Lassing and D. W. Adams.

HAZARD, KY.—Articles of incorporation were filed here incorporating the Jackson-Hazard Telephone Company, with a capital stock of $2,050. The officers and principal stockholders are: Bailey P. Wootton, president; C. X. Bowling, general manager; J. E. Johnson, vice-president; F. J. Eversole, secretary, and J. C. Boggs, treasurer. It will have lines connecting all eastern Kentucky towns. Two-thirds of the lines are now in talking order.

MORGANFIELD, KY.—The Morganfield Telephone & Telegraph Company is having a new and larger switchboard put in its exchange in this city. The board is one of the latest patterns, built by Stromberg, Carlson & Co., of Chicago, and has the drop-light attachment. It is a 300-line board.

PAOLI, KY.—Articles of association of the Paoli, Unionville & English Telephone Company have been filed in the office of the Recorder of Orange county. The capital stock has been fixed at $1,000 and the headquarters will be at Paoli. It is the intention to construct the line from Paoli to English, furnishing a cheap and efficient service to the farmers of that section.

MICHIGAN.

ALMA, MICH.—At a recent meeting of the Union Telephone Company, at Alma, a dividend of two per cent was declared, and it was voted to increase the capital stock of the company to $200,000, for the purpose of extending its lines in the territory north of Lansing.

BENZONIA, MICH.—The Benzie County Telephone Company is extending its line to Manistee. The company has had a rapid growth, having 180 local subscribers, and complete systems have been installed at Frankfort, Benzonia, Honor, Thompsonville, South Frankfort, Bear Lake and Beulah; also toll stations at Homestead, Arcadia, Eden and Onekama. The line connects with the Independent State line at Thompsonville. From a small beginning of a few hundred dollars the company has grown to a capital stock of over $10,000.

DETROIT, MICH.—The New England Telephone Company now has about 80,000 subscribers, and is adding to this number at the rate of about 1,000 new subscribers per month.

GRAND RAPIDS, MICH.—The stockholders of the Citizens' Telephone Company did not make any changes in the management of the company at the annual meeting, all of the old officers being reëlected as follows: President, C. F. Rood; vice-president, Edward Fitzgerald; treasurer, W. J. Stuart; secretary, E. B. Fisher; directors, Robert D. Graham, Philip Graham, Cyrus E. Perkins, Lester J. Rindge, E. G. Studley and J. B. Ware.

LUDINGTON, MICH.—Pere Marquette Telephone Company is incorporated, with a capital stock of $30,000.

MONROE, MICH.—The Stoddard Telephone Construction Company has been granted a franchise by the common council of Monroe for a telephone system in that city. The company is composed of local capitalists and will connect with the lines of the United States Telephone Company.

MT. CLEMENS, MICH.—The Macomb County Telephone Company has been granted a franchise by the Mount Clemens common council and will compete with the Bell Company. By the provisions of the franchise, not to exceed $24 a year for business 'phones and $12 for residence 'phones can be charged. Rates for outside service will be 10 cents for three minutes within a circuit of twenty-five miles. The company is required to put in underground conduits in the business portion of Mount Clemens.

MENOMINEE, MICH.—Ex-Governor Edward Scofield and A. L. Hutchinson, of Weyauwega, will petition the city for franchise to build and operate a telephone system here and at Marinette.

NORTH PARMA, MICH.—The North Parma Telephone Company has been incorporated, with $5,000 capital stock.

SPRINGPORT, MICH.—Springport Telephone Exchange Company; $500,000 capital stock.

MARYLAND.

BALTIMORE, MD.—The Union Telephone Company, of Baltimore county, has been incorporated by Benjamin F. Jordan, William M. Stirling, Reuben G. McCullough, J. P. Jordan, Newton W. Hershey, and James A. Gibson, of Maryland, and Joseph M. Anderson, of Pennsylvania. The company proposes to operate a telephone line from White Hall, Baltimore county, to Stewartstown, York county, Pennsylvania, and to any and all

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other points in Maryland and elsewhere. The capital stock is $3,000.

BALTIMORE, MD.—The War Department has awarded to the Maryland Telephone Company contracts for telephonic service to Forts Howard, Armistead and McHenry.

ELKTON, MD.— Maryland Telephone & Telegraph Company, of Baltimore, Maryland, has been granted franchise to erect poles and string wires in Elkton.

HAGERSTOWN, MD.— Rumors were current in Hagerstown that the Maryland Telephone Company's plant had been purchased by the Hanover (Pa.) syndicate which recently purchased lines in southern Pennsylvania and also the Westminster system. Confirmation of the report could not be obtained. It is known that the Hanover people have been after Maryland telephone stock for some time. There has been no transfer of stock on the books of the company. The paid-up capital of the company is $50,000. It is said that in addition some $25,000 of the profits has been used in making improvements.

PORT DEPOSIT, MD.—At a meeting of the Town Commissioners of Port Deposit, the privilege was granted the Port Deposit Electric Company, of Cecil county, and the Diamond State Telephone Company, to erect joint poles and string separate wires for their use thru the town, each company giving bond to the commissioners for any damage done by their respective wires. The Electric Company has purchased the Port Deposit Electric Light Company's plants, including all poles and wires thru town, and will greatly improve the plant. The Telephone Company has wires and 'phones in the greater portion of the county, and by early fall will have connection with every town and numerous detached private residences in the county.

MASSACHUSETTS.

BOSTON, MASS.—Altho the subscription books for the new stock of the New England Telephone & Telegraph Company are about to close, subscriptions are coming in very satisfactorily and there is every reason to believe that the entire issue of $2,577,000 will be taken almost entirely by present stockholders. The company proposes to use the proceeds of this new stock for the payment of outstanding obligations, amounting all told to about $1,000,000, which have accumulated, but which have never been capitalized, and the balance will be required for general construction work to the amount of something over $1,000,000 during the coming year. Plans for new construction work at present on hand contemplate nothing of special importance beyond additions to the plant necessary to meet the requirements of a business that is growing at the rate of 15,000 subscribers per annum.

FALL RIVER, MASS.—The commissioner of corporations has filed a decree authorizing the Fall River Automatic Telephone Company to issue original capital stock to the amount of $135,000.

PITTSFIELD, MASS.—The stockholders of the Stanly Electric Manufacturing Company have received letters stating that the capital stock of the company has been increased from $1,250,000 to $2,000,000.

MISSOURI.

AURORA, MO.—The Southwest Missouri Telephone Company; capital stock, $50,000. Incorporators, George R. Armstrong, Richard T. Brite and R. H. Davis.

BOLIVER, MO.—The capital stock of the Boliver Telephone Company, recently organized, is $2,500. The territory to be covered is Boliver, Richbury and Genesee.

CASSVILLE, MO.—The Southeast Missouri Telephone Company has been reorganized with $30,000 capital stock. George R. Armstrong, of Pierce City, present manager, severs his connection August 1. He will go to Oklahoma to look up new fields.

JEFFERSON CITY, MO.— Charles S. Lyttle Telephone Company has been incorporated, with a capital stock of $5,000. The incorporators are: Charles S. Lyttle, W. E. Johnson, William Bevens and others.

JAMESON, MO.—A. J. Fuller, W. T. Stovall, J. F. Brown and others have chartered the Jameson Telephone Company, with a capital stock of $3,500.

MONETT, MO.—Southwest Missouri Telephone Company, of Monett; capital stock, $50,000. Incorporated by Finley P. McGuire, A. J. Singer, R. H. Davis and others.

MACON, MO.— Statement of increase of capital stock from $10,000 to $15,000 was filed by the Macon Telephone Company.

MAYSVILLE, MO.— Charles S. Lyttle, W. E. Johnson, William Bevens and others have incorporated the Charles S. Lyttle Telephone Company at Maysville, Missouri, with a capital stock of $5,000.

PLATTSBURG, MO.— Plattsburg Telephone Company has been incorporated, with a capital stock of $10,000. Incorporators are J. C. Atchison, F. R. Allen, E. E. Bowlin and others.

STANBERRY, MO.—Gentry County Telephone Toll Line Company, of Stanberry; capital stock, $5,000. Incorporators: R. S. Liggett, J. T. Norman, J. D. Halstead and others.

SIKESTON, MO.—The Sikeston Telephone Company has increased its capital stock from $12,000 to $20,000.

ST. LOUIS, MO.—The Cowgill-Regal Telephone Company has been incorporated, with a capital stock of $1,175, by H. O. Alspaugh, J. W. Rise, C. A. Kavanaugh and others.

MINNESOTA.

CROOKSTON, MINN.—The Iron Range Telephone Company will soon rebuild its exchange and install a new switchboard for Crookston.

DAWSON, MINN.—The Fairmont Telephone Company, of Fairmont, Minnesota, is preparing to furnish rural telephone service.

ELY, MINN.—William Gallagher has been granted a franchise for a local exchange to be erected at Ely.

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MINNEAPOLIS, MINN.— H. W. Mowry, Minneapolis, who has charge of the equipment department of the Northwestern Telephone Company, is here making extensive improvements in the toll system.

MINNEAPOLIS, MINN.—The United States Telephone & Telegraph Company, of Minneapolis, is incorporated, with a capital stock of $100,000. The purpose is to establish a telephone system connecting the principal towns in southern Minnesota. The incorporators are A. T. Averill, W. H. Durwin, G. M. Averill, of Cedar Rapids, Charles Webster and G. W. Potter, of Wacona, Iowa.

NEBRASKA.

BRADSHAW, NEB.—The Bradshaw Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock of the company is $50,000.

HAVELOCK, NEB.—The Plattsmouth Telephone Company has secured a franchise and will begin at once the construction of a local telephone company at Havelock.

OMAHA, NEB.— Nebraska Telephone Company has increased its capital stock from $19,500 to $50,000.

PONCA, NEB.—Mr. Rowe, of Hartington, has sold his telephone line to Hon. J. J. McCarthy and E. E. Halstead, of this place. The line will be extended and the service improved.

NEW YORK.

ALBANY, N. Y.—The Inter-Ocean Telephone & Telegraph Company was incorporated last week with a capital stock of $2,000,000. The company will operate a telephone and telegraph system, connecting the following places: Cleveland, Ohio, Westfield, Buffalo, Niagara Falls, Rochester, Oswego, Ogdensburg, Whitehall, Syracuse, Rome, Utica, Schenectady, Troy, Albany, Poughkeepsie and New York, Newburg, Goshen, Binghamton, Cortland, Owego, Waverly, Elmira, Ithaca, Auburn, Canandaigua, Corning, Hornellsville, Geneseo, Jamestown, Salamanca and other cities and villages in New York, and Jersey City, New Jersey. The directors are Charles H. Stewart, Joel H. H. Fuller, Charles B. Stowe and Burt G. Hubbell, of Cleveland, Ohio; William T. Morris, of Penn Yan. and Harry K. Brown, of Hornellsville.

CORNING, N. Y.—The Corning Telephone Company has filed with the Secretary of State a certificate of an increase of capital stock from $1,000 to $100,000.

COHOES, N. Y.—Another telephone company to operate in Cohoes is in process of formation by some of the city's moneyed men. The system is to be purely a local one.

KANONA, N. Y.—The South Howard and Kanona Telephone Company. of Kanona, Steuben county. Directors: Edward Stewart, Frank Conlins and G. C. Barton, of Bath.

NEW YORK, N. Y.—The Telephone Printing Company, New York city; capital stock, $10,000. Directors: R. A. Saalfield, E. H. Rosenblatt and F. A. Thomson, all of New York city.

NEW YORK, N. Y.—The stockholders of the Interstate Telephone Company met in Trenton, New Jersey, on July 17, and ratified a proposition to increase the capital stock from $100,000 to $5,000,000 and issue $5,000,000 in bonds. A percentage of the money realized from the sale of the bonds will be used in construction work, while a considerable proportion of the stock will be used in paying for various companies acquired. The Interstate is one of the most important independent concerns in the country. It has acquired all the independent telephone companies in New Jersey except the system in Camden.

OSWEGO, N. Y.— Manager Joyce, of the Empire State Telephone Company, has a gang of men at work rebuilding the company's line between this city and Watertown. The men are at present working between Scriba and New Haven. The company proposes to have a metallic circuit in place of the old ground system that has been in use, which insures a perfect long-distance system between this city, Scriba, New Haven, Mexico, Pulaski, Sandy Creek and Lacona. The poles being removed by the company from the streets in this city are being used in building the line, which will be completed before the middle of August.

ROCHESTER, N. Y.—Wheeler Green Electric Company has a capital stock of $4,000.

RICHFIELD SPRINGS, N.Y.—Richfield Springs Telephone Company, of Richfield Springs; capital stock, $5,000. Directors: M. A. McKee, John Gyer and F. E. Mungor, of Richfield Springs.

TROY, N. Y.—The Hudson River Telephone Company has declared the regular quarterly dividend of 1¼ per cent, payable August 1. The directors of the telephone company, at their meeting, decided to expend between $200,000 and $250,000 to put the Troy service in fine modern condition. Everything will be new, including a new $50,000 building, for which a site has been secured, a new switchboard and all the new wires. It was decided to advertise at once for bids for the new Troy building.

WEST POINT, N. Y.—The Nebraska Telephone Company is making improvements in its plant at West Point, which amounts to $5,000. A new switchboard is being installed and the wires are being strung in cables.

WATERVLIET, N. Y.— Howard Hendrickson, for the Watervliet-Green Island Home Telephone Company, of Watervliet, filed an amended certificate of incorporation, omitting therefrom the provision for the issuance of preferred capital stock and inserting a provision that the entire capital stock shall be common stock; also reducing the amount of the authorized capital stock from $225,000 to $150,000.

NEW JERSEY.

CAMDEN, N. J.— Standard Telephone & Telegraph Company; principal office, New Jersey Corporation Guarantee and Trust

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Company building, Camden, New Jersey; object, telephone business; capital stock, $100,000. Incorporators: Frank R. Hansell, William F. Eidell and John A. MacPeak.

CAPE MAY, N. J.—Cape May Electric Company; capital stock, $100,000. The incorporators are T. Robb, L. M. Bullitt and J. M. E. Hildreth.

MILLVILLE, N. J.—Eugene Goodwin sold his telephone plant here to the Interstate Telephone Company for $44,000.

VINELAND, N. J.—The Interstate Telephone Company purchased the People's Telephone Company's plant at Vineland from Elwood C. Potter, the sole proprietor.

OHIO.

BAINBRIDGE, OHIO—Bainbridge Telephone Company has been completed and is now in operation.

CLEVELAND, OHIO—The Consolidated Electric Construction Company, Cleveland, Ohio, has been incorporated, with a capital stock of $25,000, by C. C. Bateson, F. C. C. Werk, Abraham Oppenheimer, A. A. Bemis and P. A. Zizleman. The company will deal in electrical materials and supplies.

CLEVELAND, OHIO—The Stark County Telephone Company has completed its line from Kenton to Alliance, connecting Canton, Massillon, Wooster, Alliance, Sebring, Salem, East Liverpool and Pittsburg, in connection with the United States lines. The intention now is to connect Canton and Cleveland.

COSHOCTON, OHIO—The Citizens' Telephone Company has given an order for an entire new equipment to the Kellogg Switchboard & Supply Company. The directors of the Citizens' Company are Messrs. Joseph L. Rue, L. P. Gallagher, C. L. Cassingham, A. N. Compton, H. C. Herbig, B. W. Ricketts and William Burns.

COVINGTON, OHIO—The Sidney Telephone Company has increased its stock from $40,000 to $60,000.

DAYTON, OHIO—Quarters in the Reibold building have been secured by the Home Telephone Company, of Dayton. It is said the plant will cost about $650,000 when completed. The wires will be placed underground within a radius of a mile and a half of the center of the city.

EAST LIVERPOOL, OHIO—Wellsville Electric Light Company has increased its capital stock from $30,000 to $100,000.

HIGHLAND, OHIO—Permission has been granted to C. E. Hull, of Salem, to build a telephone line along the highways in this county. The work of obtaining the right of way will be commenced at once, and the line will start within sixty days, and be extended from Sandoval to this city, via Shattuc and Huey, and thence north to Keyesport, west to Jamestown, and on to Troy, where connection will be made with the Kinloch system of St. Louis. Mr. Hull intends to connect every town in the county by telephone, and establish an exchange here. The charge for 'phones will be: Business houses, $2; residences, $1 a month, which gives to each subscriber the privilege of talking anywhere on the system without extra charge. A line will also be built for the exclusive use of the farmers.

HAMILTON, OHIO—Frank J. Baber, of Hamilton, has invented a receiver which is to be fastened to the wall, instead of held in the hand. A slight pressure with the ear opens the current and calls the central office, and when the pressure is relieved the current is closed. It is so arranged that it may be raised or lowered to suit various heights.

KENTON, OHIO—The Kenton Telephone Company increased its capital stock from $30,000 to $50,000. Horton Park is secretary of the company, and James L. Moore president.

KENTON, OHIO—The new switchboard of the Home Telephone Company, of Kenton, has been put into service, with 150 drops.

LONDON, OHIO—The London Telephone Company has 582 'phones in its exchange here, with new ones being put in every day. Vienna and Plattsburg are now connected with London. There are between forty and fifty 'phones in the new Midway Exchange. Mr. McLean, formerly with the C. U. people, is engaged in getting the Midway line in excellent working order.

MARYVILLE, OHIO—The telephone line between here and Milford Center is completed and is now in operation.

MILLERSBURG, OHIO—The Killbuck Telephone Company has asked for a franchise of the council of Millersburg. This is the second application they have made, the first one having been lost and its standing is not known, so they commenced anew. They propose to charge $1.50 per month for business houses, and $1 for dwellings. This is 50 cents less for the former than is charged by the Millersburg, Wooster & Orrville Company and the same on latter. There is a suspicion that the Killbuck Company is seeking the franchise for the purpose of selling it to the Bell people, who have a toll station here only, and were refused a franchise. There appears to be general satisfaction over the charges and service of the local company now operating here and the granting of a franchise to the Killbuck Company is very doubtful.

NEW LEXINGTON, OHIO—The Perry Telephone Company is incorporated, with a capital stock of $25,000.

NORWALK, OHIO—The Buckeye State Telephone Company; capital stock, $10,000.

SEBRING, OHIO—The Columbiana County Telephone Company will enlarge and improve its plant at Sebring.

SHADE, OHIO—Jerseyville Telephone Company has been incorporated, with a capital stock of $3,000.

SIDNEY, OHIO—Sidney Telephone Company has increased its capital stock from $30,000 to $60,000.

TOLEDO, OHIO—The Home Telephone Company filed a bond of $27,500 with Probate Court Judge Millard as a guarantee that the company will construct a new telephone line in this city and have the same in full opera-

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tion December 31, 1903, with 3,000 subscribers.

WOODSFIELD, OHIO—Amendments have been filed to the articles of the Fort Dodge Telephone Company, increasing the capital stock from $25,000 to $50,000.

PENNSYLVANIA.

CHAMBERSBURG, PA.—The Cumberland Valley Telephone & Telegraph Company sold out last week to S. L. Johns, of McSherrystown; T. J. O'Neill, Harry N. Gitt and J. W. Gitt, of Hanover, for a price said to be nearly par, $25, for the $100,000 worth of stock. The line is 180 miles long and covers forty towns and villages in Franklin county. The same men own the Adams county, Hagerstown, Westminster and other lines, and all are to be combined. The company will rival the Bell lines.

MAUCH CHUNK, PA.—At a special meeting of the Mauch Chunk Town Council, the telephone ordinance was adopted, granting permission to the Carbon County Telephone & Telegraph Company to erect and maintain a telephone line in the borough.

NEWVILLE, PA.—An automatic telephone exchange will be placed at Boiling Springs by the Home Telephone Company. The apparatus does away with all operators.

PHILADELPHIA, PA.—A combination is being formed of eight independent telephone companies in Pennsylvania. The company to take over these concerns is the Conslidated Telephone Company, capital $6,000,000, which succeeds the Schuylkill Valley Company, capital $500,000.

READING, PA.—The stockholders of the Central Pennsylvania Telephone & Supply Company, and the Pennsylvania Telephone Company, of Harrisburg, voted to consolidate their interests and become a portion of the combine formed at Reading, to be known as the Consolidated Telephone Companies of Pennsylvania. Richard O'Brien, of this city, will be the general manager of the consolidated companies. Headquarters, Reading.

WELLSBORO, PA.—Northern Pennsylvania Telephone Company has been incorporated, and will install an exchange, with a capital stock of $12,500.

WILLIAMSPORT, PA.—A new telephone line is to be built thru Tioga, Potter, McKean, Bradford and Lycoming counties by the Northern Pennsylvania Telephone Company, which is now making application for a State charter. The company is to operate telephone and telegraph lines. Among the stockholders are Hugh Young, G. W. Williams, M. D. Howe, B. J. Bowen and H. C. Young, all of Tioga county.

TENNESSEE.

CHATTANOOGA, TENN.—The Overton Telephone Company, of Overton county, has filed an amendment to its charter increasing the capital stock to $20,000.

GEORGETOWN, TENN.—East Tennessee Telephone Company will construct system in Georgetown.

GAINESBORO, TENN.—The Gainesboro Telephone Company has filed a bill against the Overton Telephone Company to prevent it from interfering with its lines by placing wires close to its wires and also seeks an injunction to restrain the Overton Company from operating its line to Cookeville, Tennessee, because messages sent over either line are carried into the switchboards of the other company. The operator of the Overton Company was notified that an injunction had been granted and the lines would not be used. There is much speculation as to the outcome of this litigation and the suit promises to be an interesting one.

HUNTINGDON, TENN.—At a recent meeting of the Carroll County Telephone Company, the following directors were elected: L. E. Brevard, president; A. M. Lee, J. McN. Wright, L. P. Clark. J. McNeil Wright tendered his resignation as secretary-treasurer, and is succeeded by J. Fred Walters. The rates have been raised from $1.50 to $2 on business houses and from $1.25 to $1.40 on residences.

HENDERSON, TENN.—The New Home Telephone Company has secured a franchise to operate a telephone system in Henderson.

JACKSON, TENN.—A franchise has been granted the Jackson Home Telephone Company to operate a telephone system at Jackson.

KNOXVILLE, TENN.—The People's Telephone & Telegraph Company, of Knoxville, Tennessee, is erecting a new exchange building and an underground conduit system for the accommodation of 3,000 subscribers. A new switchboard has been ordered and will be installed during July. The system when completed will be one of the best in the South. Every subscriber will have an individual metallic circuit, and the company has purchased what it believes to be the best obtainable.

MEMPHIS, TENN.—The City Council of Jackson, Tennessee, has granted a franchise to an independent telephone company, which will coöperate with the Memphis independents in the long-distance arrangements.

SPARTA, TENN.—The Gainesboro Telephone Company, with headquarters at this place, has just installed a multiple switchboard which will accommodate 1,500 drops. Two operators, one for the city exchange, and the other for toll lines, will be in charge of this board. The business of this line is increasing rapidly and demands the putting on of another operator.

TEXAS.

ALPINE, TEX.—Alpine-Terlingua Telephone Company, of Alpine; capital stock, $1,000. Incorporated by A. M. Turney, R. L. Neville and J. C. Bird.

BOYD, TEX.—E. A. Fatherree, of Boyd, and R. M. Moore, of Fort Worth, have formed the Boyd Telephone Company, and now have a force of men at work erecting a line at Garnia, and the intention is to extend it in the near future to other points.

BEAUMONT, TEX.—Beaumont Telephone Company, of Beaumont, Tex.; capital stock,

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$60,000. Incorporated by Melville D. Shaw, Charles N. Haskell, James Kingduffy, James A. Boynton, Charles H. Roser, Sheppard H. Van Womer and William H. Aldridge.

COLUMBIA, TEX.—The Brazoria County Telephone Company, of Columbia; capital stock, $10,000. Purpose, to operate a telephone line from Columbia to Rosenberg and Richmond, connecting with Angleton, Alvin, Houston, Brazoria, Velasco, Quintana, Van Vleck and Bay City; incorporators, L. L. Smith, Jr., R. B. Loggins and J. E. Duff.

FORT WORTH, TEX.—Representatives of seventeen independent telephone companies and exchanges in Texas, Indian Territory and Oklahoma, met at Fort Worth, Texas, on July 17, and formed a permanent organization, with Edward Nims, of Roff, Indian Territory, as president. The convention determined that all independent telephone exchanges within the section named were eligible to membership in the organization. The telephone situation in Texas, Oklahoma and Indian Territory and the proposed extension to the stock-ranch region were thoroly discussed.

GALVESTON, TEX.—Claude Roberts, superintendent of construction for Texas Construction Company, will arrange for constructing an independent long-distance telephone line between Houston and Galveston.

GALVESTON, TEX.—The Southwestern Telephone Company, of Galveston, Texas, is completing its underground conduit system, which represents a cost of nearly $80,000.

MCKINNEY, TEX.—The D. C. Telephone Company has been incorporated, with capital stock of $10,000, by J. B. Ray, W. A. Rhea and J. E. Mitchell for maintaining a system of telephones.

RICHMOND, TEX.—The Richmond-Damon Mound Telephone Company, of Richmond; capital stock, $10,000. Incorporators: D. R. Pearson, John W. Moore, T. B. Wessendorff and others.

SAN ANGELO, TEX.—San Angelo Telephone Company, of San Angelo; capital stock, $80,000. Purpose, to operate a telephone system. Incorporators: J. G. Rust, J. W. Sims and L. Rust.

SAN ANTONIO, TEX.—The Commercial Telephone Company has been incorporated at San Antonio, Texas, with a capital stock of $500,000. It proposes to build 1,100 miles of toll line, extending from Houston to San Antonio, Galveston, Orange, Dallas and Fort Worth. The officers of the company are: President, H. M. Audrey; vice-president, Z. B. Campbell; secretary, C. H. Roser.

SILVERTON, TEX.—Capital stock to the amount of $1,200 was subscribed to build a telephone line from here to Estelline, on the Fort Worth & Denver City Railroad, a distance of sixty-five miles. The line will be rushed thru and will soon be in operation.

VERNON, TEX.—The Vernon Telephone Company has purchased the Vernon electric light plant and consolidated the two systems under the name of the Vernon Light & Power Company.

VERNON, TEX.—A company has been organized here to build a telephone line from this place to Quanah and Crowell, Texas, and Altus and Enid, Oklahoma. Work will be begun at once.

VIRGINIAS.

FINCH, W. VA.—The Finch Telephone Company, of Finch, West Virginia, has been incorporated for the purpose of establishing a telephone line; capital stock, $8,000; paid in, $150. Incorporators: E. J. Schofield, W. J. Wince, W. A. Bungardner, M. S. Boggs and N. H. Williamson, all of Finch.

GOOSE LAKE, W. VA.—Independent Home Telephone Company, of Goose Creek, West Virginia; capital stock, $5,000. Incorporators: R. T. Rhinehart, B. Biell, D. E. Douglass, S. S. Cowell, J. B. Russell, A. C. Satterfield, J. A. Garrison, all of Goose Creek.

PARKERSBURG, W. VA.—A movement has been started and a meeting of the interested parties already held, to merge all the independent telephone lines in West Virginia into one company. It is estimated that the value of the property under the consolidation will reach $1,000,000. The new company will be capitalized for several times that amount. A committee has been appointed to inspect and report upon the various properties.

RICHMOND, VA.—Richmond Telephone Company will install new equipment of switchboards and instruments and otherwise improve its service.

STAUNTON, VA.—The Long-Distance Telephone Company of Virginia held its annual meeting at Staunton, when the officers and directors for the next year were chosen. The following officers were elected: J. R. Kemper, president; C. W. Scott, vice-president. Simon R. Curtis, of Warwick county, was put on the board of directors in place of F. W. Sims, of Louisa county. The board then held a meeting and elected Mr. George A. Gulley secretary. The company will increase its capital stock to $100,000, and will build lines to connect with Richmond and Baltimore.

WISCONSIN.

BARABOO, WIS.—William J. Bell, manager of the Baraboo Telephone Company, has secured a franchise to erect poles and string wires to Kilbourn and establish a telephone exchange. A new line between Baraboo and Kilbourn will be erected.

DODGEVILLE, WIS.—The Union Telephone Company is building a line from Dodgeville, Wisconsin, to Jonesdale. The line will be extended as far as Blanchardville.

EAU CLAIRE, WIS.—The city council granted a franchise to the Osseo Telephone Company. It is prohibited from combining with any existing company.

JANESVILLE, WIS.—The Farmers' Telephone Company. The capital stock is $2,100.

MADISON, WIS.—Articles of incorporation were filed by the Luxemburg Telephone Company to build telephone lines in Kewaunee and Brown counties. The capital stock is

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$1,000. The incorporators are Dr. Felix Moraux, F. H. Patterson, Peter Boucher and A. J. Peterson.

MADISON, WIS.—The annual meeting of the Standard Telephone & Electric Company was recently held at Madison, Wisconsin. The capital stock of the company was fixed at $300,000. Mr. Thomas H. Gill, attorney for the Wisconsin Central Railway, of Milwaukee, Wisconsin, was elected president; A. L. Hutchinson, of Weyauwega, Wisconsin, vice-president and general manager, and E. W. Batchelder, of Madison, secretary and treasurer.

MILWAUKEE, WIS.—The Milwaukee Citizens' Telephone Companv has been incorporated, with a capital stock of $25,000.

NEENAH, WIS.—A franchise was granted the Fox Valley Telephone Company.

MARINETTE, WIS.—Attorney W. B. Quinlan filed with the city clerks of Marinette and Menominee applications for a franchise to build and operate telephone systems in both cities. The applicants for the franchise are former Governor Edward Scofield, of Oconto, and A. L. Hutchinson, of Weyauwega.

PLEASANT VIEW, WIS.—The new farmers' telephone line from Belmont to Pleasant View has been completed, and will be extended to Darlington.

RHINELANDER, WIS.—The Rhinelander Mutual Telephone Company's line at Clintonville, Wisconsin, has been sold to the new telephone company at Rhinelander, Wisconsin.

UNION GROVE, WIS.—After paying incidental expenses and repairs, the Union Grove-Paris Telephone Company has paid a dividend of eighteen per cent to stockholders. Arrangements are being made to extend the line from Paris to Bristol.

WAUSAU, WIS.—Wausau capitalists are planning to organize the Wisconsin Valley Telephone Company with a capital of $75,000.

OTHER STATES.

PHOENIX, ARIZ.—The articles of incorporation of the International Wireless Telegraph & Telephone Company, just filed at Phœnix, specify a capitalization of $25,000,000, the largest ever known in Arizona. The shares are $5. The incorporators, each subscribing to 100 shares, are: M. V. Gehring, Harry Shoemaker, R. Leaman, William J. Moss and Henry S. Bass, all of Philadelphia, which will be the principal place of business. Phœnix, Boston, New York and Washington will also have offices.

PETALUMA, CAL.—The Sunset Telephone Company has purchased the local system of the Petaluma Home Telephone Company and will hereafter run an extended system in this city.

HARTFORD, CONN.— Southern New England Telephone Company has sent out circulars announcing that hereafter the time limit of communications with persons outside the State will be reduced from five minutes to three, with a corresponding reduction for the initial period. Hereafter, a communication with New York, for instance, will cost 60 cents for three minutes instead of the old rate of 90 cents for five minutes. The night rate will be 30 cents for three minutes instead of 50 for five.

WILMINGTON, DEL.—The Consolidated Telephone Company has a capital stock of $1,000,000; to buy, sell, lease and operate telephone and telegraph lines.

CONCORDIA, KAN.—The Concordia Telephone & Telegraph Company, of Concordia; capital stock, $20,000. Directors: George G. Hill, Washington; William Lutt and F. W. Daugherty, Concordia.

TOPEKA, KAN.— B. F. Pankey was granted a franchise by the council and will install a new telephone system. He will put in copper metallic long-distance instruments for $36 a year, while the Missouri and Kansas company charges $60 a year for the same service.

TOWSON, LA.— Messrs. B. F. Jordan, W. M. Sterling, R. G. McCullough, J. P. Jordan and others have incorporated the Union Telephone Company; capital stock, $3,000.

MEXICO.—A certificate of incorporation has been placed on file for the Mexican National Telephone Company, of Philadelphia; capital stock, $1,000,000; to conduct and operate a telegraph and telephone system in the Republic of Mexico.

PORTLAND, ME.—The annual meeting of the Dirigo Telephone Company of Maine has been held at the office of the company. The following officers have been elected for the coming year: President and general manager, Lewis A. Goudy; treasurer and superintendent of exchanges, E. L. Durgan; superintendent of construction and electrician, Herbert H. Niles; clerk, Oscar H. Hersey; corporation counsel, Foster & Hersey; directors, Lewis A. Goudy, Oscar H. Hersey, John J. Frye, Portland; Melville H. Kelly, Saco; William J. Nash, Boston. It was voted to increase the capital stock of the company to $250,000, of which $100,000 is preferred first lien 6 per cent stock, and $150,000 common stock. The company also authorized the issuance of 6 per cent bonds for the expansion of its service. The work of placing poles to bring the service from the Deering district into the city proper has been begun.

CONCORD, N. H.—The Meredith Telephone Company has been organized, with these officers: President, B. Blaisdell; vice-presidents and directors, J. F. Beede, George H. Clark, F. W. Towle, B. R. Dearborn; secretary and treasurer, P. A. Ellsworth.

OKLAHOMA CITY, OKLA.—The Long-Distance Telephone Company has a capital stock of $5,000. The directors are George Todd, Oklahoma City; J. F. Noble, Shawnee; E. D. Nims, Roff, I. T.

GUTHRIE, OKLA.—The Topeka & El Reno Telephone Company was chartered by Secretary Grimes. The capital stock is $10,000. The directors are W. F. Evans, of Topeka, Kan.; H. B. Low, of Fort Worth, Tex.;

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F. H. Wright, of El Reno; G. W. Bellamy, of El Reno, and O. O. Blake, of El Reno.

NEWPORT, R. I.— Newport, Rhode Island, has lately been struggling with poor telephone service, but something better is promised, and the difficulty is not one that the company can well be blamed for. During the past spring there has been a material increase in the number of subscribers, and there are more than 830 now on the board.

TACOMA, WASH.— E. A. Seely has been granted a franchise for an independent telephone system in Tacoma.

SEATTLE, WASH.—The Seattle Automatic Telephone Company is prosecuting the work of installing its new plant with great energy. It has ordered wire and cables to the extent of $160,000, and has fifteen carloads of iron material on the way. At a cost of $125,000, large switchboards are being made, with an ultimate capacity of 12,000 'phones.

ARTIFICIAL SUBMARINE CABLE.

Mr. Augustus Trowbridge describes in the June number of the *Physical Review* a neat form of artificial submarine cable which can be made at a comparatively small cost. The earlier forms of artificial submarine cables involved the use of very large condensers made with tinfoil at great expense, and the author's method is, therefore, to be welcomed as a means of providing artificial submarine cables at a much cheaper rate for technical schools. The essential element in such cables is the appreciable time lag which they must have, and in order to get this they must have both large resistances and large capacity. The author has made use of the great polarization capacity which a cell consisting of dilute sulphuric acid with platinum plates has when the applied E. M. F. has a value below the maximum polarization of the cell. The artificial cables are accordingly built up of a series of resistances, between each of which is connected to the earth return one of these cells. These electrolytic capacities consisted in the experiment recorded in the article of short lengths of glass tubing about 1 cm. in diameter, with a platinum wire as an electrode sealed into one end. The tube was filled nearly full of distilled water, and the other electrode, which was a piece of platinum foil about 3mm. wide, was corked in so as to dip about 5mm. into the water. In the cable the author has made he used thirty-nine such cells, arranged in thirteen sets of three cells each. The three cells of each set were connected in parallel. Thirteen resistances aggregated about one million ohms. The galvanometer had a figure of merit of 10^{-8} amperes, which made a signal giving a small but very definite throw of the instrument. The author states it will be found convenient to mount the cells on a thin board in which a triple row of holes are drilled just large enough to allow the wire electrodes to project a few millimeters from the under side, and to have this board rest on another, in which are three troughs filled with mercury to serve as an earth connection for all the wire electrodes. In this way, if the board carrying the cells be lifted, all capacity is at once removed from the system, and a signal is sent along the conductor with no appreciable time lag. In other words, when the board is lifted the submarine cable becomes an overhead land line of the same length as the cable. With the apparatus described above, the time lag when the capacities are in is very appreciable, being in the neighborhood of six seconds. Of course, the E.M.F. of the battery used must be less than the maximum polarization of platinum electrodes in water, and therefore a single Daniell or Leclanché cell is suitable.

THE PROSPECT OF TRADE WITH SPAIN.

The prospects of American manufacturers securing a large share of the Spanish trade are very hopeful. Already, in spite of the discriminating tariff, American electrical machinery and apparatus are finding a good sale in the country of the Dons, as will be seen from a perusal of the official statistics of the past two years. In 1899, American electrical machinery to the value of $3,326 was imported into Spain, while in 1900 the value had increased to $14,753. In imports of American instruments and apparatus for scientific purposes, including telegraph, telephone and other electric, the increase is even greater, the value for 1899 being $7,747 as compared with $37,614 for the fiscal year just ended.

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TRADE NEWS.

ELECTRIC APPLIANCE COMPANY.

The Electric Appliance Company Chicago, has issued and is sending free to those interested, a neat little book entitled "Practical Telephone Manual." It is full of useful information for telephone men and was written and compiled by Mr. S. A. Dinsmore, head of the company's telephone department.

WESTERN TELEPHONE CONSTRUCTION CO., CHICAGO.

The business of the "Western" has been large during June and July. In addition to receiving and filling contracts for multiple and central battery apparatus, including a recent order for twelve hundred capacity, complete central-battery equipment, for the Pan Telephone Company, Fort Smith, Arkansas, orders have also been received for from fifty to four hundred line switchboards from Embreeville, Chadd's Ferry, Honey Grove, Muncy, Newberry, Tamaqua, Hanover, Coatesville and Bellefonte, Pa.; Brandon, Vt.; Orange, Mo.; Greenwood, Miss.; Paullina and Wayland, Iowa, and Lestershire, N. Y. Orders for Western Express No. 1, No. 3 and central-battery telephones are large. The "Western" not only enjoys the distinction of being "the pioneer" independent telephone manufacturing company of the United States, but also owning and operating its own factory, one of the largest plants devoted exclusively to the manufacture of telephone apparatus. The new factory is located at Winthrop Harbor, Illinois, north of Chicago, and is most complete in all details. The offices and salesrooms of the company are in the Fisher building, Chicago, which customers and friends are cordially invited to visit when in Chicago.

THE CONNECTICUT TELEPHONE AND ELECTRIC COMPANY.

The Connecticut Telephone & Electric Company, Meriden, Connecticut, reports a very large sale of its magneto bells and telephones. Its shunt is all it claims for it, a marvel of simplicity.

SWEDISH-AMERICAN TELEPHONE COMPANY.

This company reports an unusual sale of its new transmitters. It will be pleased to send you a description of this new device.

THE EUREKA ELECTRIC COMPANY.

The Eureka Electric Company reports an unusual run of business. This company is installing a great number of its new flash-light boards.

AMERICAN ELECTRIC FUSE COMPANY.

Manager Jones, of the American Electric Fuse Company, reports that their new ¾ cent renewable fuse is the greatest selling specialty they have ever had, and that means a great deal. They will be pleased to furnish samples and descriptive matter to any one interested.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY.

The Kellogg Switchboard & Supply Company, speaking of its display at the Pan-American Exposition, state that its visitors' list contains the names of a great number of leading telephone men who have visited this interesting and instructive exhibit at Buffalo. This company's line is one that stands prominent in the independent field.

THE COLUMBIA TELEPHONE MANUFACTURING COMPANY.

This company has something new in a receiver, transmitter, generator, ringer and switchboard. These are all described in the company's very handsome circular, which it will be more than willing to trade with you; that is, you offer your address and it offers the circular.

PALM-FECHTELER AND COMPANY.

Palm, Fechteler & Co. manufacture transfer ornaments. Speaking to Manager May, of the Chicago branch, he said he did not know there were so many telephones in the country, from the amount of transfer ornaments he has been selling in the country. This company's line will improve the appearance of any telephone to such an extent

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that every telephone company ought to use them.

WESTERN ELECTRICAL SUPPLY COMPANY.

Western Electrical Supply Company, St. Louis, Missouri, has something new in its "synchronized clock system." Every telephone company should become aware of how easily they may increase their revenue by a slight investment in the synchronized clock system. This company will be pleased to furnish complete information upon request.

THE NORTH ELECTRIC COMPANY.

The North Electric Company, Cleveland, Ohio, reports a large sale of its complete system of "dividend payers." This company always has some new and up-to-date literature, which it will be pleased to send to your address upon receipt of request.

STANDARD TELEPHONE AND ELECTRIC COMPANY.

The Standard Telephone & Electric Company, of Madison, Wisconsin, is now issuing a new line of descriptive matter on its well-known apparatus. It would like to have your address.

THE STERLING ELECTRIC COMPANY.

The Sterling Electric Company, of Lafayette, Indiana, will be pleased to inform you about its lines of protection. This company makes a fine line of protective devices for telephones and switchboards.

WHEELER ELECTRIC CONSTRUCTION COMPANY.

The Wheeler Electric Construction Company, Chicago, Illinois, at present have several squads constructing exchanges in different parts of the country. Mr. Wheeler, in behalf of his company, makes the claim that it can build an exchange cheaper than you can, and would be pleased to hear from you.

AMERICAN TOLL TELEPHONE COMPANY.

The American Toll Telephone Company will be pleased to add you to its school, and place you in line for its instruction as to the value of measured service. To use its own language, write for information regarding measured service.

ROBERT L. McOUAT.

Robert L. McOuat, Indianapolis, Indiana, states that he is selling a great many telephones, cross-arms, oak brackets, locust and oak pins, leather nail-heads and dry batteries. This company manufactures all of the above goods and claims to be able to make some inside prices and prompt shipment.

THE GARTON-DANIELS COMPANY.

The Garton-Daniels Company, Keokuk, Iowa, would like to send you one of its extension circuit ringers. You are referred to the proposition which it makes in the advertising pages of this issue.

McROY CLAY WORKS.

The McRoy Clay Works report a large sale of their "smooth article"—"McRoy conduits."

WILLIAMS-ABBOTT ELECTRIC COMPANY.

The Williams-Abbott Electric Company, Cleveland, Ohio, will be pleased to send you a description of its new "Euclid set."

CHICAGO FUSE WIRE AND MANUFACTURING COMPANY.

"A transformation." The Chicago Fuse Wire & Manufacturing Company says that it will be lucky for you to send for its new catalog, No. 13.

ELECTRIC APPLIANCE COMPANY.

The Electric Appliance Company, Chicago, are putting out a new dry battery under their well-known name "Eaco," which they especially recommend for telephone work, and where heavy service is required.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY.

We are in receipt of a handsome and instructive catalog from the Stromberg-Carlson Telephone Manufacturing

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Company. This catalog contains illustrations and descriptions of their well-known make of apparatus. The catalog contains sixty-four pages and is handsomely printed. They are sent free to those who desire them.

INTERNATIONAL TELEPHONE PUBLISHERS.

We are in receipt of the twenty circuits published by the International Telephone Publishers, of Grand Rapids, Michigan. They are the circuits of twenty different styles of telephones and are something that should be in demand by every telephone man.

THE AMERICAN ELECTRIC TELEPHONE COMPANY.

The American Electric Telephone Company is now issuing a new line of descriptive matter pertaining to American apparatus. This company always has something new and it would be an advantage to you to get your name upon its mailing list. This company will be pleased to put you there upon receipt of your name.

THE WESTON ELECTRICAL INSTRUMENT COMPANY.

The Weston Electrical Instrument Company, who is now supplying nearly all the instruments to the leading telephone companies, has issued a new catalog, which it will be pleased to send you.

CHILI TELEPHONE COMPANY (Ltd.)

The directors' annual report to March 31 states that the aggregate number of subscribers at all centers was 4,723, compared with 4,613 at the beginning, a gain of 110. The gross revenue in Chili was $683,170, compared with $651,436 in 1900, an increase of $31,734. The expenditure in Chili was $347,413, against $364,549, a decrease of $17,136. The net income in Chili was, therefore, $335,757, against $286,887, an increase of $48,870.

The average rate of exchange for the year was 16.65d., compared with 15.17d., an increase of 1.48d. Converted into sterling the figures for 1901 were £23,290, against £18,130 in 1900, an increase of £5,160.

The liquid assets and liabilities in Chili on March 31 were valued at 17d., compared with 16½d. at the corresponding date last year. This increased value represents £800, which has been carried to reserve.

The balance to credit of revenue, including £1,003 brought forward, is £18,879, of which £5,199 has been carried to reserve for depreciation and renewals. The directors recommend a dividend of 5s. per share, tax free (5 per cent), absorbing £11,000, £2,680 to be carried forward.

During the year the capital outlay was £488, and the total mileage of lines on March 31 was 8,591 miles 548 yards, compared with 8,298 miles 990 yards in 1900, an increase of 292 miles 1,318 yards.

STATEMENT OF ALEXANDER GRAHAM BELL.

At a recent interview Alexander Graham Bell made the following statement: "Do you know that there are nearly 2,000,000 miles of telephone wires in the United States alone? If these wires were fastened together they would encircle the earth eighty-one times. The total number of telephone calls in this country last year was 1,820,000,000. At the rate of 1 cent per call this would amount to enough pennies to form a double row around the globe, and there would be enough left over to make three rows across the Atlantic. And all this has been accomplished in a single generation.

"I have recently been traveling thru Norway and Sweden, and I was surprised to note the wonderful progress made by the telephone in these countries. In proportion to the population there are more telephones in Norway and Sweden than in any other country, even in America.

"The next great step in the improvement of the telephone will be wireless telephony. This is not an inventor's dream. It has already been done across short distances. In the immediate future it will be made practical for social and commercial purposes."

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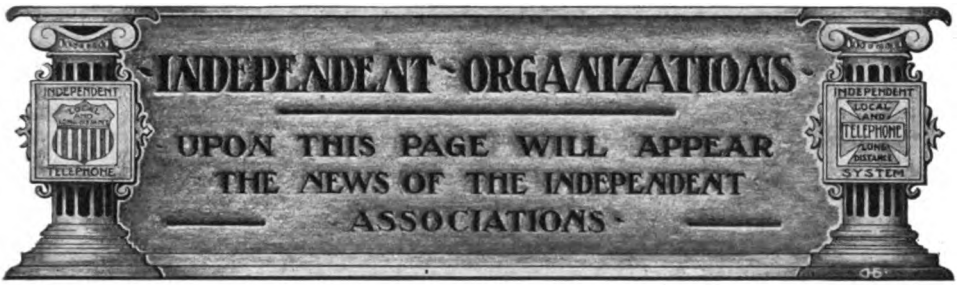

THE INDIANA CONVENTION.

The annual meeting of the Mutual Independent Telephone Association of Indiana was held in Lafayette on July 29 and 30, and was attended by a representative of almost every company in its territory. The meeting was called to order in Thomson Hall by the vice-president, Charles M. Zion, of Lebanon, who introduced the mayor of the city, Hon. Noah Justice, who spoke as follows:

"Mr. Chairman and Gentlemen of the Convention: It has fallen to my lot, as mayor, to extend to you the good will of our city in your behalf during your labors here in convention assembled.

"We appreciate your coming here. We appreciate your efforts to be of service to the people. We appreciate your success so far in being able to hold your own against giant combinations who would wipe you from the face of the earth if they could command the power.

"A combination of the people for the good of the people, so long as it remains with that object in view, will maintain its credit with the people and be sustained by them against every opposition.

"It is the history of these efforts when coöperation by the masses is for the good of all. We, the people, will succeed because we have always youth with us. In the language of the great Cardinal Richelieu, 'In the lexicon of youth there is no such word as fail.'

"And now, in conclusion, let me say to you the city is yours, the proverbial key is in your possession, the latch string hangs loose on the outer door. Enter in at the opening and partake of the good things in store for you. Again we welcome you in the name of the people of our city. The superintendent is instructed to take good care of you while in the city."

Judge L. C. Walker, attorney for the New Telephone Company, at Indianapolis, read a paper entitled: "The Late Bell Monopoly — It Lived Unloved and Died Unmourned." The speaker said in the course of his address:

"I can not, within the time I have allotted me, give more than an approximation of the growth and extent of that business that has been developed since 1895. But I do affirm that there is no parallel in the history of any business in this or any other country, where there has been such growth and development, and involving millions of expenditure as in the construction and operation of the independent telephone plants since 1895; it is without a parallel in the world's history of business."

After a brief discussion of the subject, the convention adjourned until the next morning at 9:30 o'clock.

At the second day's session, a number of new members were elected to the association.

The chair appointed Rome C. Stephenson, of Rochester, Ohio, T. Spencer, of Dansville, and E. Van Seckle, of Dana, as a committee to audit the books of the treasurer.

Upon motion of S. P. Sheerin, of Indianapolis, the thanks of the association were extended to the Lafayette Telephone Company, the Sterling Electric Company and the citizens of Lafayette in general for their hospitality and magnificent entertainment of the visitors.

The manner of dealing with railway companies was discussed at length and it was found that in many places the roads pay full rate for all 'phones used

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by them. In fact, this is the prevailing custom in this State.

The convention then voted to go into the election of officers.

Walter E. Doolittle, of Lafayette, placed in nomination for president, L. A. Frazee, of Connersville, and the nominations were closed. Mr. Frazee was declared to be the unanimous choice of the association.

C. A. Zion, of Lebanon, and Harry B. Gates, of Indianapolis, were re-elected vice-president and secretary and treasurer, respectively.

After the election was over, Mr. Frazee said:

"Fellow citizens of Indiana and Independent Telephone men:

"I thank you most sincerely for the honor you have conferred upon me.

"Were it a talk of argument against our competitor, words would be in abundance; were it concerning the independent movement, words would be in abundance; but to express my feelings on this occasion, words fail me.

"I feel it a special honor to be one that is engaged in this great work of telephony. It is a work for the people."

The newly elected president, Mr. Frazee, presided over the session.

A paper, "Our Friends, The Enemy," was read by George P. Haywood, attorney for the Lafayette Telephone Company. Owing to the inability of Mr. Beers to be present his paper was omitted.

C. A. Reaves, Plymouth, Ind., read a paper on "The Coöperation of Independent Telephone Companies," and E. H. Andress, president Carroll County Telephone Company, Lafayette, one on "Progress of Independent Telephony."

After some discussion of the general workings of the association, the convention adjourned.

Those present said that never before were the delegates and guests entertained as at this meeting, and all left sounding high the praises of the Sterling Electric Company and the Lafayette Telephone Company.

On the afternoon of the first day street cars were provided, giving the visitors a complete view of the city, and in the evening all were taken to Woodland Park, where a vaudeville performance was specially provided.

On the second day, the Sterling Electric band escorted the delegates to the Sterling factory, and in the evening a banquet was tendered at the German National Park.

Among those present were:

J. A. Rush, Home Telephone Company, Columbia City, Ind.

L. A. Frazee, Connersville Telephone Company, Connersville, Ind.

James A. Peterson, Darlington Telephone Company, Darlington, Ind.

O. J. Grimes, Thorntown, Ind.

H. G. Lutz, Odell Telephone Company, Shadeland, Ind.

E. H. Hammond, American Electric Telephone Co., Chicago, Ill.

S. Tudor, Citizens' Telephone Company, Kokomo, Ind.

William H. Turner, Citizens' Telephone Company, Kokomo, Ind.

H. B. Gates, New Telephone Company, Indianapolis, Ind.

J. A. Morarity, New Telephone Company, Indianapolis, Ind.

E. S. Vanwinkle, Post-Glover Electric Company, Cincinnati, Ohio.

F. W. Warner, Warner Electric Company, Muncie, Ind.

Addison Nordyke, Indianapolis, Ind.

George W. Fair, Fair Telephone Company, Chrisman, Ill.

Ora F. Frazee, Ridgeville Telephone Company, Ridgeville, Ill.

W. Bissell, F. Bissell Company, Toledo, Ohio.

E. Vanseckle, Dana, Ind.

Arthur A. Anderson, Standard Underground Cable Company, Pittsburg, Pa.

P. J. Eubanks, American Electric Telephone Co., Chicago, Ill.

L. G. LeBourveau, Sumter, S. C.

W. O. Meissner, Acme Electric Company, Chicago, Ill.

J. A. Kenny, American Electric Fuse Company, Chicago, Ill.

H. B. McNeal, Editor *Telephony*, Chicago, Ill.

J. G. Nolan, Columbia Telephone Company, Chicago, Ill.

J. P. Hutchins, Kokomo, Ind.

Rome C. Stephenson, Rochester, Ind.

O. Rex, North Manchester, Ind.

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S. A. Dinsmore, Electric Appliance Company, Chicago, Ill.
D. F. Holliday, Electric Appliance Company, Chicago, Ill.
C. P. Platt, Kellogg Switchboard Supply Company, Chicago, Ill.
Lewis C. Warren, New Telephone Company, Indianapolis, Ind.
S. P. Sheerin, New Telephone Company, Indianapolis, Ind.
A. B. Carlton, Mugg Telephone Company, Quincy, Ill.
A. H. Nordyke, New Telephone Company, Indianapolis, Ind.
Oscar Carman, Indianapolis, Ind.
David L. Canmann, Eureka Electric Company, Chicago, Ill.
I. J. Kusel, Eureka Electric Company, Chicago, Ill.
Joseph Heath, Oxford, Ind.
Joseph Stingle, Oxford, Ind.
Ezra Fix, Boswell, Ind.
Abraham Halleck, DeMotte, Ind.
F. B. Kimbill, Crown Point, Ind.
J. F. Bruner, Rensselaer, Ind.
H. E. Adams, Illinois Telephone Company, Chicago, Ill.
A. D. Pyke, Romney, Ind.
Grant Holwerda, Cairo, Ind.
J. J. Nate, Madison, Wis.
J. C. Eckhart, Buck Creek, Ind.
J. D. Stingle, Oxford, Ind.
George F. Trier, National Telephone Company, Fort Wayne, Ind.
John Switart, South Whitley, Ind.
S. Morrison, Greenfield, Ind.
F. R. Strickler, Franklin, Ind.
R. F. Blount, Wabash, Ind.
Wilder Kendall, Wabash, Ind.
O. T. Spencer, Danville, Ind.
J. E. Newman, Danville, Ind.
C. D. McConohay, Anderson, Ind.
F. D. Rusling, Indianapolis, Ind.
W. H. Pearl, Chicago, Ill.
W. T. Heddon, Chicago, Ill.
Phil Adler, Lebanon, Ind.
Fred G. Balz, Indianapolis, Ind.
C. H. Fister, Elkhart, Ind.
C. H. Keene, Plymouth, Ind.
W. C. Knott, Plymouth, Ind.
J. E. Switzer, Otterbein, Ind.
F. G. Gilmore, Greencastle, Ind.
Frank Koontz, Bremen, Ind.
Claude R. Stoops, Nappanee, Ind.
John E. Yarlin, Peru, Ind.
W. A. Wright, Hillsboro, Ind.
H. E. Rasmussen, Indianapolis, Ind.
M. A. Jordan, Logansport, Ind.
Carl Carpenter, Perrysville, Ind.
Ernest Grey, Rainsville, Ind.
Velda C. Klepinger, Battle Ground, Ind.
W. A. Caldwell, Chicago, Ill.
J. H. Davis, Danville, Ill.
J. L. Horny, Clinton, Ind.
F. Knickerbocker, Danville, Ind.
U. S. Thompson, Fithian, Ind.
I. M. Hollingsworth, Warren, Ind.
E. B. Walker, Delphi, Ind.
John E. Combs, Mulberry, Ind.
George H. Metler, Mulberry, Ind.
R. T. McGillian, representing Valentine, Clark & Co., Chicago.
A. J. Kusel, editor TELEPHONE MAGAZINE, Chicago.

REPORT OF ANNUAL CONVENTION SOUTHERN INDIANA TELEPHONE ASSOCIATION.

The annual convention of the Southern Indiana Independent Telephone Association, which closed at New Albany lately, was largely attended and proved an enjoyable and profitable meeting. Short talks were given by Mr. Coleman, of Louisville; Judge George B. Cardwell, James W. Dunbar, of New Albany; E. W. Pickhardt, of Huntingburg; J. E. Zeluff, of Toledo, Ohio; S. A. Dinsmore and J. J. Knarl, of Chicago, and a number of others. At the closing session of the association Philip Dilley, treasurer of the Dubois County Telephone Company, at Huntingburg, read a paper on "Free Service; Ought There Not to Be a Limit?" Other papers were read by J. W. Ladd, of Dale, Indiana, on "Is It Profitable to Furnish Telephone Service at 50 Cents per Month?" L. G. Davis, of Salem, on "Farmer's Lines; How to Make Them Profitable to the Local Exchange," and Charles F. Stevens, of Princeton, on "Benefits of Metallic Lines Over the Grounded System." The officers of the association were reëlected. They are: C. A. Kienle, Huntingburg, president; Charles D. Knoefel, New Albany, vice-president; E. W. Pickhardt, Huntingburg, secretary; T. M. Thom, Lamar, treasurer.

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Telephone Magazine

VOL. XVIII. CHICAGO, SEPTEMBER, 1901. NO. 120.

TENSION AND SAGS IN TELEPHONE AND TELEGRAPH WIRES.

By CHARLES E. LAWRENCE.

With the advent of wireless telegraphy we find ourselves freed from many perplexing problems, the outcome of the use of bare copper wires, strung upon poles, and exposed to the variations of temperature as well as to the fury of storms of all sorts.

While today we have in commercial use the wireless telegraphy, yet it promises to be many years before we shall be rid of the ubiquitous overhead wire. It will not be immediately that the principle of the Marconi system of wireless communication will be applied to the telephone, especially in the congested districts of our large cities.

Few people using the long line of copper wire, extending between New York and Chicago, fully appreciate the many problems that entered into the construction of that line, before uninterrupted service between those two great business centers could be reasonably guaranteed.

When two parties are engaged in conversation over a line between the above points, for the time they are the sole owners of two thousand miles of No. 8 copper wire, which has been strung for their benefit, according to the best engineering principles, embodying the demands of efficiency and economy. Nor is it true only of the line above cited, but also of all other lines that are built for the same ends, however short they may be.

In stringing such a line it is the desire of all engineers to use as few poles as possible, consistent with economy and safety. Where the poles are placed too far apart, the span becoming excessive, the sag or dip in the wire must be made considerable, consuming more wire, putting the wire nearer the ground, thus exposing it to greater danger.

Thus a saving in poles means a loss in wire, a greater danger factor, while the line itself is generally weaker. There is a point therefore where economy prohibits the use of a smaller number of poles per mile, that is a limit is placed on the length of the span. Experience has fixed the number of poles per mile at from forty to fifty, depending upon the size of the line. These limits are sometimes exceeded in the case of extremely light lines, while in case of very heavy lines, the poles may be set nearer than the above figures.

Assuming then that the distance between poles is fixed, we have next to determine the sag or dip in the wire itself to insure safety and economy. By the "dip" is meant the distance of the lowest point on the wire from the straight line joining the points of support. To determine this we must consider all the conditions that may be imposed upon the wire. Where some conditions are exceedingly unlikely, it may be the part of economy to ignore rather than to consider them. On the exposed coast of New England it is a common occurrence in the winter season for a heavy sleet storm to be succeeded by a gale of considerable violence. These conditions may hold from time to time on the coast of Florida, but the intervals are so long that it would be cheaper to suffer a line to go down before such a storm than to construct it sufficiently strong to withstand it. Circumstances may demand that

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service be uninterrupted, in which case we can not afford to disregard even the rarest conditions, tho such practice is not general.

When a cord of uniform weight and density is suspended between two points, with no other load than itself, it assumes a definite curve, known as the catenary. The form of the catenary depends upon the weight per unit-length of the cord, the length of the cord and the distance between the points of support (assuming the points of support are in a horizontal line). When these three values are fixed, the curve is determined, hence the sag or dip is fixed. In Fig. 1 is shown a cord, suspended at the ends, hanging in the form of the catenary. The length of the span is l, measured from A to C, while L, the length of the cord, is measured along A, B and C.

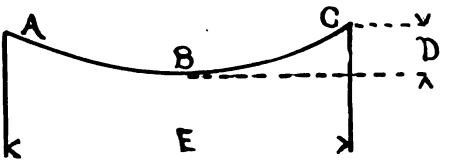

FIG. 1.

If L, the length of the cord, be increased or diminished, while l, the length of span, remained the same, the form of the curve would be changed, but it would still be a catenary, following all the laws of that mathematical curve.

It is easy to see that when the span l is increased, the length L remaining the same, the sag or dip d (see Fig. 1) is reduced. Still another change has taken place, which is not manifest to the eye; the tension t in the cord is increased. It will be seen that as the dip is thus made to diminish, the tension increases very rapidly, until, when the dip becomes zero the tension becomes infinite. Thus it is quite obvious that unless the cord were absolutely without weight, it would break before the dip became zero.

It may be reasonably claimed that wires may be strung with respect to the tension, disregarding the sag. That may be true, and would be an excellent method in places where the temperature was very uniform thruout the year, and where no other load than its own weight is to be imposed upon the wire. But such conditions do not obtain generally in this country, and for such cases this treatise would not apply.

In running wires the easiest thing to measure after the length of span is the sag in the wire; if that is predetermined for the conditions holding at the time the wire is strung with a view to the conditions that may obtain at other times, then we have an easy method of constructing a line with a reasonable factor of safety. That is, if a line is to be constructed when the temperature is 100° Fahr., and the sag is made sufficiently large so that when the temperature falls to 30° below zero and the wire is coated with sleet in the presence of a gale of seventy miles an hour; if after the contraction, due to a fall in temperature of 130° Fahr., the tension has not exceeded its safe limit; if the additional weight of sleet and the additional load due to the wind do not yet increase the tension to the point of breaking, then the wire has been strung according to engineering principles and not by chance. It must be, however, that under these extreme conditions the wire approaches quite nearly the breaking strain, also the demands of economy would be disregarded.

As was stated above, when the sag is reduced for a given span, the tension was increased, but the increased tension causes the wire to elongate, so that the action is somewhat complicated, as will be seen.

The mathematical expression for a cord suspended between two horizontal points is

$$y = \frac{h}{2}\left(l^{\frac{x}{h}} + e^{-\frac{x}{h}}\right).$$

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The significance of that expression will be more easily understood from a figure, but no effort will be made here to deduce it mathematically. Referred to the lines Ex and Ey as axes the curve has the equation given above, where y is the distance measured vertically from Ex, and x is the horizontal distance to the right or left of Ey, negative when the value is taken to the left; $D\,E$ is the value h in the equation and for convenience is taken as the ratio of the tension at the lowest point D to the weight per unit of length of the wire, while e is the base of the Napierian logarithms.

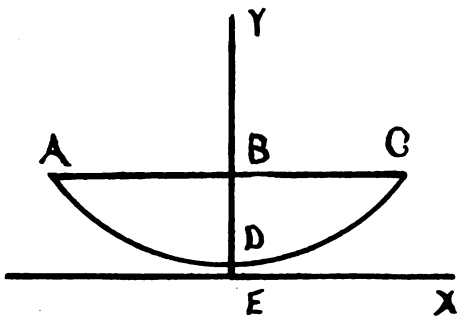

FIG. 2.

We shall not deal with equation in the form given above, but shall modify it somewhat without destroying its applicability to the case in hand.

According to the well-known principle, propounded by McLaurin, this equation can be expanded into the following form:

$$y = h\left(1 + \frac{x^2}{1.2h^2} + \frac{x^4}{1.2.3.4h^4} + - - -\right),$$

where the unwritten terms involve high powers of h, and render them negligible. For the case in hand it is sufficient to retain only two of the terms in the parentheses, giving: $y = h + \frac{x^2}{2h}$.

Following along the curve we see that when x is equal to BC (or half the span), if y is equal to BE, or to $BD + h$, which shows that in the expression $y = h + \frac{x^2}{2h}$ we have a value for the sag of the curve, when x is made equal to half the span. Thus by substituting $\frac{l}{2}$ for x we have $y = h + \frac{l^2}{8h}$, where $\frac{l^2}{8h}$ is the value of the sag within reasonable limits.

We have really departed from the catenary and have deduced an equation which represents a second curve, that is a parabola. It was stated above that h was the ratio of the tension (at D) to the weight of the wire per unit of length or $\frac{T}{P}$. In the case under discussion the tension thruout the entire length of the span is practically the same, so that T may be taken as the maximum tension.

By the proper application of the integral calculus for finding the length of the cord in the arc, the following expression may be deduced: $L = l + \frac{l^3P^2}{24T^2}$, where L is the length of the suspended cord, l is the length of the span, P is the weight per unit length of the cord, and T the tension at the lowest point.

The correct expression for L is $L = l + \frac{8D^2}{3L}$, where $D = \frac{Pl^2}{8T}$, or $L = l + \frac{8P^2l^4}{3L\,64T^2} = l + \frac{P^2l^4}{24LT^2}$.

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For simplification it may be assumed that $l = L$ in the last term, whence $L = l + \frac{P^2 l^3}{24\, T^2}$ as given above.

We are now ready to calculate the sags that must be allowed for different spans at different temperatures, and the method of procedure will be as follows: assume that the temperature is the lowest that will be met in practice, allow a reasonable factor of safety for the dangers arising from sleet and wind, calculate the sag necessary at that temperature, and then determine what that sag becomes as the temperature varies.

Thus we shall have a table of sags for different temperatures in steps from the lowest to the highest.

Suppose we assume that the minimum temperature to which the wire will be subjected is 25° below zero. At that temperature the wire is at its minimum length, and it would be safe to string it with the proper tension at 25° degrees below zero, for with a rise of temperature the wire would elongate, and the tension would be reduced.

But it is not always convenient to string wires at such low temperatures, nor is it ever desirable to do so. Hence after determining the proper sags for this temperature we must calculate the changes that occur in the length of the wire, as the temperature increases, and thus determine the safe sags for all temperatures between the highest and the lowest. As a means for protecting against outside conditions, such as sleet, wind and imperfections in the wire, a suitable factor of safety must be chosen; that is, the tension at the minimum sag must be some fraction — one-third or one-fourth of the breaking strength of the wire.

As all material is elastic within limits, it changes its form when the forces acting upon it are altered. If a wire strung between two supports has its tension doubled, the length of the wire (measured between two marked points on the wire within the points of support) increases; that is, the wire stretches; and upon returning to the initial tension the length will be found to be as it was at first; assuming that it has not been stretched beyond its elastic limit, a point where the wire draws out like a piece of putty, having lost its elasticity.

When therefore the temperature rises the wire expands, due to the action of the heat, whereupon the tension decreases, but the decrease in the tension causes the wire to shorten because of its elasticity, and we have an action in each direction, but not equal.

Both of these actions are calculable and must be taken into account.

It will be found that after determining the sag for the lowest temperature it will be simpler to vary the tension and determine the corresponding temperature and sags, than to proceed in the contrary way.

We have already seen that, for any given temperature, the length of wire in a given span was $L = l + \frac{P^2 l^3}{24\, T^2}$, where l is the span, P the weight per unit length, and T the tension. Suppose now that the temperature changes, then the new length becomes $L = l + \frac{P^2 l^3}{24\, T^2}$, where the tension has changed to T. This length would be easily calculable in terms of L, knowing the degrees rise in temperature, and the co-efficient of expansion of the wire, were the material non-elastic.

Assume c = co-efficient of linear expansion.

" t = number of degrees (F.) rise in temperature.

" m = modulus of elasticity of the wire.

That is c is the fractional increase in length for each degree (Fahr.) rise in temperature, and $\frac{1}{m}$ is the increase per unit of length for every pound increase in tension per square inch of cross-section.

To make this plainer still, if a wire 100 feet long is not under tension and the

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temperature rises 10° Fahr., then the length becomes $100(1+10c)$ feet; if the wire be under tension, and that tension be increased, while the temperature remained constant, then the new length is $100 \cdot \frac{1}{m}\frac{T-T_1}{S}$, where $T-T_1$ is the change in tension, and S is the cross-section. These two conditions co-exist, however, and must be treated accordingly.

If L were the initial length of our wire, then after a rise of $t°$ in temperature the tension has changed from T to T_1, then the new length $L_1 = L + Lct - \frac{T-T_1}{mS}L$.

$$\text{But } L = l + \frac{l^3P^2}{24T^2} \text{ and } L_1 = l + \frac{l^3P^2}{24T_1^2}.$$

$$\text{Wherefore } l + \frac{l^3P^2}{24T_1^2} = \left(l + \frac{l^3P^2}{24T^2}\right)\left(1 + ct - \frac{T-T_1}{mS}\right).$$

$$= l + \frac{l^3P^2}{24T^2} + lct - \frac{l(T-T_1)}{mS} + \frac{l^3P^2}{24T^2} \cdot \left(ct - \frac{T-T_1}{mS}\right).$$

$$\text{or } l + \frac{l^3P^2}{24T_1^2} = l + \frac{l^3P^2}{24T^2} + lct - \frac{l(T-T_1)}{mS} + \text{a term easily negligible, as } c \text{ is}$$

very small, and m very large. For copper wire $c = 0.00000925$, $m = 19000000$.

$$\text{Whence } lct = \frac{l^3P^2}{24}\left(\frac{1}{T_1^2} - \frac{1}{T^2}\right) + \frac{l}{mS}(T-T_1).$$

$$\text{or } t = \frac{l^2P^2}{24c}\left(\frac{1}{T_1^2} - \frac{1}{T^2}\right) + \frac{1}{mSc}(T-T_1).$$

Thus we have an expression for the change in temperature in terms of the initial and resultant tension.

By ascribing to l, P, c, m and S their proper values, our equation reduces to $t = A\left(\frac{1}{T_1^2} - \frac{1}{T^2}\right) + B(T-T_1)$, where A and B are determinable constants; A alone varying with the length of span.

Suppose now we have determined the proper sag and tension for a temperature 25° below zero, and call the tension T; next assume a new tension T_1, and substitute the values in the above equation for t, and thus find the value of t that corresponds to the change in tension from T to T_1.

From T_1 determine the sag, which will be the proper sag for the temperature $-25+t°$ Fahr. Proceed in this way by small jumps until the temperature has reached the maximum to which the wire is to be subjected. From these points a curve may be plotted, and the temperatures intervening may be read off with the corresponding sags.

It will be seen that in the equation given above $t = A\left(\frac{1}{T_1^2} - \frac{1}{T^2}\right) + B(T-T_1)$, $A = \frac{l^2P^2}{24c}$, and $B = \frac{1}{mSc}$; wherefore A varies as the square of the span, A varies as the square of the weight of the wire per unit length directly, inversely as the co-efficient of expansion of the material, while B varies inversely as the modulus of elasticity, the cross-section and the co-efficient of expansion of the wire. If then we change the span, the weight of the wire or the co-efficient of expansion, we must calculate a new A, and proceed as we did at first; the same is true of B, if m, s or c is varied.

It must also be kept in mind that the above deductions are for bare wires, carrying their own weight only. In practice we must deal with many departures from these conditions, first the insulated wire, then the twisted pair, and lastly the lead-covered cable. In the first case we have added extra weight without strength, while the other conditions remain the same. The danger from accumulated ice and

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snow has been increased. In the case of the twisted pair, we depart further yet from the point of safety, while a new danger is introduced, one wire may be made to carry the burden of its mate. It must not be overlooked that in this case we have two helices, but the error is quite small when they are considered as acting like straight wires. The writer has made some personal investigation along these lines and has found that theory is well borne out in fact. In these experiments the tension was measured by means of spring balances, one on each wire; the tension was varied by means of blocks and tackle, while the sags were measured on a pole erected at the middle of the span, on which was marked the horizontal line joining the points of support. This line could be accurately found by sighting from one point of support to the other, while an assistant marks the point on the middle pole (sufficiently offset not to intercept his line of vision) where the line of vision passes. In the case of a lead-covered cable we have new conditions again, for the cable is never allowed to carry any burden, but is suspended from a supporting wire. Here then we have a wire carrying many times its own weight, with multiplied chances for collecting sleet and ice. The importance of the supporting wire is greatly increased, for upon it depends the many wires massed in the cable, now unable to support themselves.

The same principle underlies the whole thing, however, so that the several cases may be all treated alike, with proper attention to the particular exigencies in each case.

In actual practice the length of spans may vary from seventy-five (75) to three hundred (300) feet or more, so that the preparation of tables for the many lengths of span would involve considerable labor, for which reason this has been left for the reader to calculate for his own particular case or cases.

TELEPHONIC COMMUNICATION BETWEEN ENGLAND AND BELGIUM.

An interesting article on the steps that are being taken to establish telephonic communication between England and Belgium is published in the *Transactions* of the Société Belge d'Electriciens. Up to the present time there are only two submarine telephone connections of any appreciable length — namely, between Buenos Ayres and Monte Video and London and Paris. The former of these was established in 1899, and includes two distinct cables, each containing a single strand of copper wire. The cables themselves are 45 km. long, and 4 mm. overhead wires, 70 km. and 187 km. in length, are connected at each end of these, so that the total distance is 302 km. The resistance of the cable is 3.3 ohms per kilometer, and its insulation and capacity 700 megohms per kilometer and 0.20 microfarads per kilometer respectively. The land-line has a resistance of 1.38 ohms per kilometer. The three telephone cables between Dover and Calais, the first of which was laid in March, 1891, each contain four conductors simply stranded, the go and return conductors for the same circuit being placed diagonally to one another. The length of the cable is 40 km., the overhead wire to London 135 km., and to Paris 325 km., these two overhead wires being of copper, 4 mm. and 5 mm. diameter respectively. Thus the whole length is 515 km., about a third of which is gutta-percha covered cable. Each of the four conductors is seven-strand, with a total diameter of 2.35 mm. and a resistance of 7.56 ohms per knot. The total capacity after immersion is 5.52 microfarads, and the insulation resistance reduced to 24° Cent., about 2,000 megohms. The product KR is 5,500 for the Buenos Ayres-Monte Video circuit and 7,400 for the London-Paris line. Between London and Brussels the distance is 400 km., the submarine part between Dover and La Panne being 90 km. long, or 22½ per cent of the whole. Arrangements are being made so that Birmingham, Manchester, Liverpool, Antwerp and Liège can make use of the line as well as the two capitals. Tests were originally made to see if it would be possible to establish communication between England and Belgium, via Lille and the Calais-Dover cable.

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THE NEW TELEPHONE EXCHANGE AT MUNICH.*

The subscribers' lines in the Munich telephone system are led into two spacious and conveniently situated exchanges known as "Exchange I" (Max Josephplatz) and "Exchange II" (Bahnhofplatz). Each office was originally fitted with indicator boards for fifty subscribers; but, in 1895, Exchange I was furnished by the Western Electric Company with multiple switchboards capable of accommodating six thousand subscribers. Altho these boards have been barely four years in operation, and are not yet fully fitted up, they are no longer up to date. The indicator boards in Exchange II were replaced last year by a multiple-switch installation of the most modern construction, the system of communication between the local exchanges was greatly improved, and an entirely new office was fitted up for trunk-line traffic.

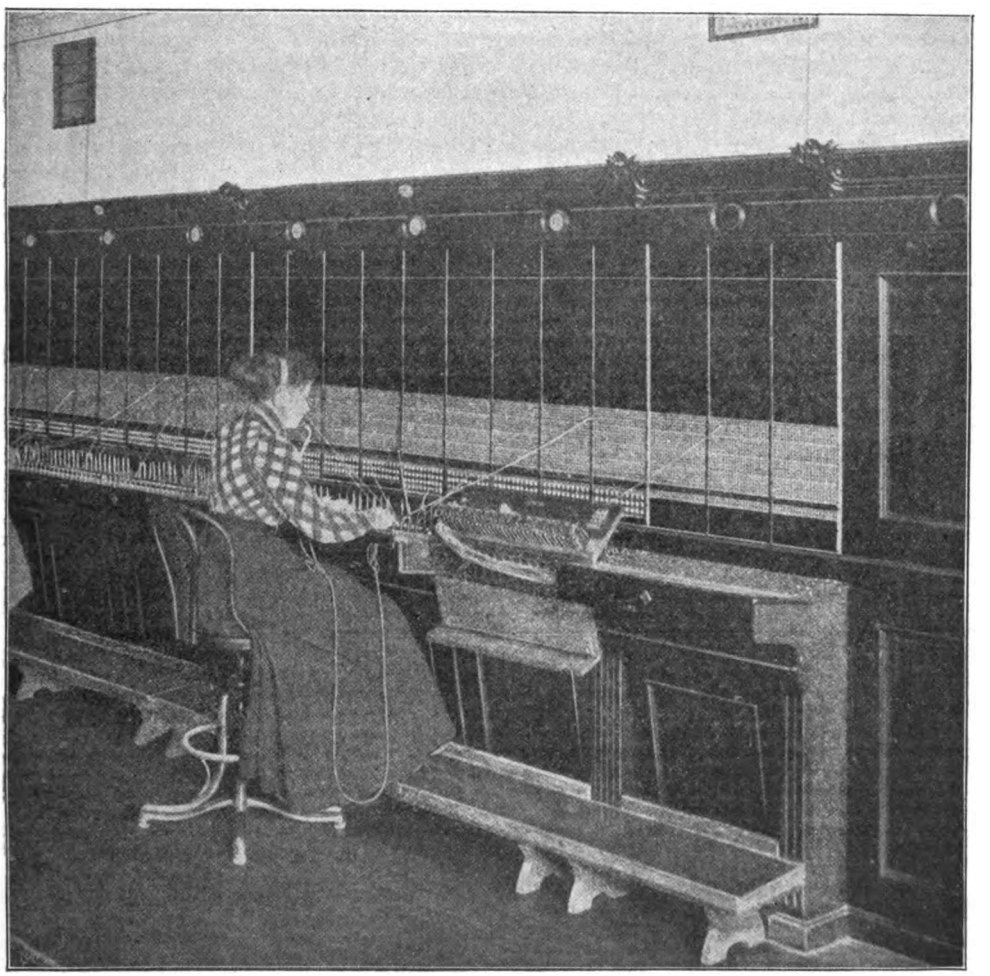

FIG. 1.

EXCHANGE II.

The characteristic feature of the new exchange (II) is the use of glow lamps, by which the whole of the indicators have been replaced. The fact that the lamps are placed immediately over the

* Abstract from the *Elektrotechnische Zeitschrift*.

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corresponding local jacks saves an immense amount of time. Whereas the operator formerly had first to read the number of the fallen indicator, and then to look for the subscribers' jack bearing the same number in another part of the board, she now simply inserts the plug in the jack directly under the lighted lamp without troubling herself about the number of the calling subscriber. At the new Munich exchange it has been shown that a skilled operator can more easily and comfortably attend to 150 subscribers — assuming the number of conversations to be the same — than 120 in the old exchange. In a fully equipped exchange of 10,800 lines the annual saving in the salaries of the switch staff alone, as a result of this economy, would amount to at least £2,700.

The switch-room has an area of 280 square meters and a height of 3.7 meters, and can be extended when necessary. The dynamo and accumulator room is separated from the switch-room only by a passage. Forty-two wire cables are led from the principal distributing frame into the switch-room thru a fireproof chasing let into the wall. Near this chasing the series of multiple boards commences, the first being the trunk-line communication board, in which the junction wires from the trunk-line office terminate. Next in order come three junction boards, to which the junction wires from Exchange I are brought, and then follow twelve subscribers' boards. The iron frames for supporting the various relays are fixed to the walls behind the respective switchboards; but a free passage 75 cm. wide is left between them and the back of the switchboards. Close by is a board with meters for registering the connections made to the various operators' positions of the subscribers' boards.

The switchboards are built with vertical jack tablets, and are, of course, arranged for metallic-circuit working. With a view to insure prompt communication between subscribers, the capacity of the exchange has been limited to 10,800 lines. The extent to which the size of the jacks has already been reduced may be gathered from the fact that, in the new exchange, 10,800 multiple jacks require less space than 6,000 jacks in Exchange I, and that for the reception of these 10,800 jacks a space 60 cm. high by 180 cm. wide is sufficient.

The subscribers' boards (Fig. 1) are arranged on the double-cord system; the junction boards for local and trunk line communication are arranged on the single-cord system. Each subscribers' board is divided into three operators' positions, with one hundred subscribers' lines per operator, so that the twelve subscribers' boards, as at present arranged, suffice for 3,600 subscribers. Each board is, therefore, for the present, fitted with only 3,600 multiple jacks distributed over nine vertical panels. Below these there is in each second operator's position a lamp and a single jack, from which a wire goes to record table II at the trunk wire office; then follow 270 junction wire jacks for communication with Exchange I. The lowest part of the jack space is occupied by the call lamps, arranged in rows of ten, and the corresponding answering jacks. The keyboard of each operator's position is equipped with fifteen pairs of plugs and cords, fifteen clearing lamps, fifteen combined speaking and calling keys, a calling-back key, a control lamp, a call-signal lamp, and five speaking keys, with five lamps for the service wires to Exchange I. The connector for the operator's telephone is placed just under the keyboard.

The panels of the local junction boards are furnished with 3,600 multiple jacks each. Each operator's position has thirty single cords and plugs, thirty clearing-signal lamps, thirty combined speaking and calling keys, one control and one call lamp.

The trunk junction board is fitted with break-jacks grouped in seven vertical panels. Each of the three operator's positions is equipped with the same number of cords, keys and lamps as the local junction board, and with a plug of special construction.

The connections of the local exchange are shown in Fig. 2. The subscribers' double lines are brought from the prin-

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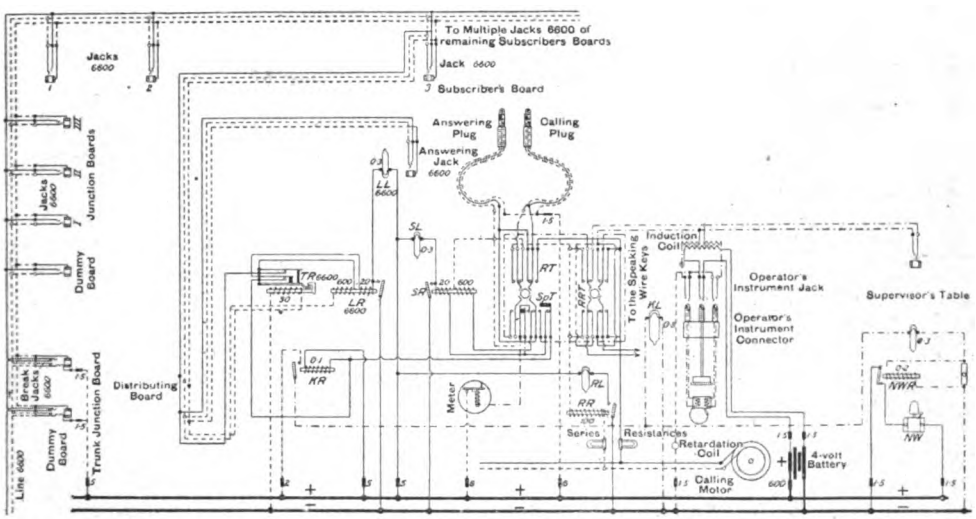
cipal distributing board in forty-two-wire lead-covered cables; twenty pairs corresponding to the twenty jacks of a strip are led to the break-jacks of the trunk junction board, leaving two wires spare. The similarly numbered jack strips of all the boards are then connected by means of sixty-three-wire cables, the two lines and the test wire being required for each subscriber. Much cable is saved by connecting the multiple cable with the call relays at the various boards. For example, at the first subscribers' board, to which subscribers 6,000-6,300 are connected, cables branch off from multiple jacks



LL, line lamp; SL, signal lamp; KL, control lamp; RL, call lamp; TR, cut-off relay; LR, line relay; KR, control relay; SK, signal relay; RR, call relay; RT, calling key; SpT, speaking key; RRT, calling back key; NWR, night bell relay; NW, night bell.

FIG. 2.—CONNECTIONS OF SUBSCRIBERS' BOARD.

6,000-6,300 to the upper soldering tags of the intermediate distributing board, and then pass from the lower tags to the subscribers' jacks on the one hand, and to the respective cut-off or line relays on the other hand.

Fig. 3 shows the method of connecting two subscribers belonging to Exchange II. It is assumed that subscriber No. 6,051 calls up the exchange; the incoming alternating current returns thru the contact *l* of the cut-off relay and the main coil *l* of the line relay; the armature of the latter is attracted and closes the contact *c*. The call lamp lights up the circuit of the common battery, being completed thru *a*, the lamp, and the contact *c*; but at the same time the retaining coil *h* of the line relay is energized and the armature thereby prevented from falling back. The circuit is: Positive pole *b*, coil of control relay, contact *h* of the cut-off relay, retaining coil *h* of the line relay, contact *c*, negative pole. The common control relay for the whole of the calling and clearing lamps of an operator's position now also acts and lights up the control lamp and the lamp at the supervisor's table. Circuit: Positive pole *c*, contact *c*, c^1, control and supervisor's lamps in parallel, negative pole. Normally the control lamp always glows when a calling or clearing lamp lights up. If the former alone glowed this would be a proof that one of the calling or clearing lamps at the operator's position was defective. The faulty lamp could then be easily found by plugging the subscribers' jacks or by turning the speaking key. As soon as subscriber 6,051 turns his magneto, his call lamp, the control lamp and the supervisor's lamp glow. The operator then takes one of her answering plugs, inserts it in the jack directly underneath the call lamp, pulls over the lever of the speaking key and receives the

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demand of the subscriber. On inserting the plug its sleeve, *k*, comes into contact with the socket *k* of the jack. A current now circulates from the positive pole *d* thru *d'*, third wire of the cord *k*, coil of the cut-off relay, to the negative pole. The cut-off relay attracts both armatures and breaks contact at *h* and *l*. Breaking contact at *h* releases the armatures of the line and control relays; the line lamp, the control lamp and supervisor's lamp consequently go out. By the opening of the contact *l* actuated by the alternating current from the motor, and will cause the call lamp, which is furnished with a red opal lens, to glow. As a rule, calling is effected thru the connecting plug, and only in isolated cases is it necessary to call back thru the subscriber's plug to the originating subscriber. If, for example, No. 6,051 has to be called up again the combination key is brought into the speaking position, and the calling-back key pressed forward for a moment. On inserting the connecting plug in

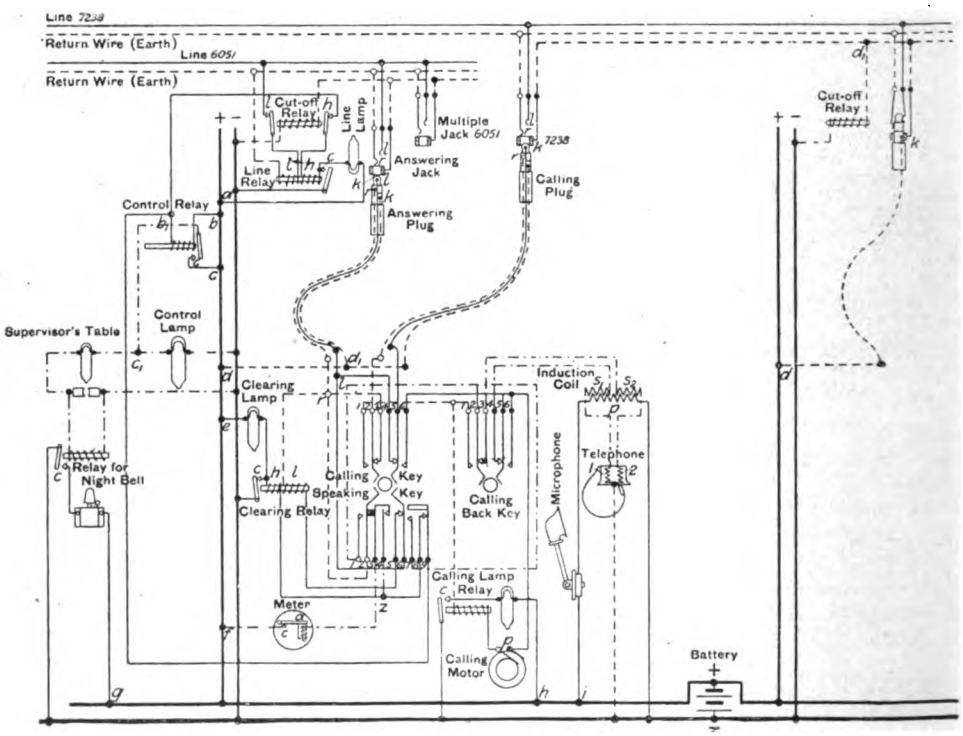

FIG. 3.—KEYBOARD CONNECTIONS.

the main coil of the line relay, which is normally bridged across the subscribers' loop, is cut out. Suppose subscriber 6,051 wishes to speak to 7,238. The operator takes the second, or calling plug, of the cord she is using, and tests multiple jack 7,238 in the usual way. If the line is free the operator makes the connection and calls up subscriber 7,238 by pulling forward — upward in Fig. 3 — the lever of her combination key for a moment. The coil of the call relay inserted in the call circuit will be multiple jack 7,238, the main coil of call-relay 7,238 will be cut out of the loop, so that during the conversation only the main coil of the clearing relay remains in bridge across the loop, whereas in the drop indicator system three electromagnet coils remain in.

When the conversation is finished and the subscriber rings off, the main coil *l* of the clearing relay is energized, the armature is attracted and closes the contact *c*. This, on the one hand, causes the clearing lamp to glow, and, on the

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other, brings in circuit the retaining coil *h*. The circuit is: Positive pole *b*, coil of control relay, b^1, springs 9 and 8 of the combination key, coil *h*, contact *c*, negative pole. The control lamp and the lamp at the supervisor's table light up again. On seeing the clearing signal, the operator reverses the combination key, then brings it to the normal position and withdraws the two plugs from the jacks. On reversing the combination key, contact between springs

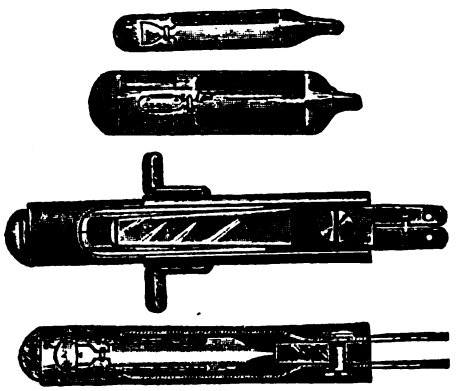

FIG. 4.—INDICATOR LAMPS.

3 and 4 is made before contact between 8 and 9 is broken. The magnet of the meter attracts its armature and registers the connection. The breaking of the contact between springs 8 and 9 causes the armature of the clearing relay to fall back and thereby extinguishes the clearing and control lamps and the lamp

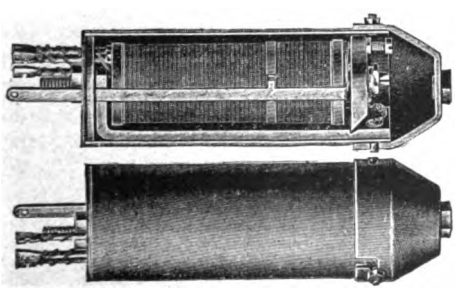

FIG. 5.—SUBSCRIBER'S CALLING RELAY.

at the supervisor's table. The supervising officer can, therefore, see directly, by the lighting up and extinguishing of the lamp on his table, whether the calling and clearing signals are immediately attended to; he can, moreover, go into any operator's speaking circuit and listen to all the conversation which passes.

The lamps are represented in Fig. 4, *a* and *b*; they do not require more space than the subscribers' jacks, and can be

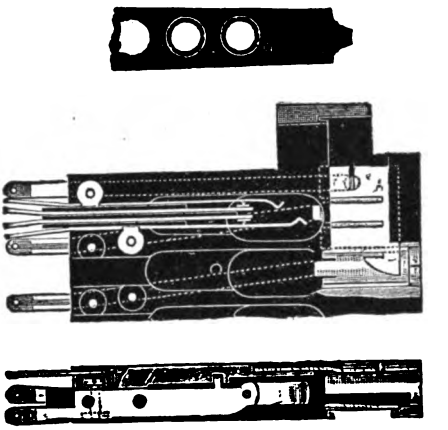

FIG. 6.—BREAK JACK ON TRUNK BOARDS.

mounted directly over the latter in so-called "lamp-jacks" (Fig. 4, *c* and *d*), which are furnished with thick opal lenses, in order to soften the light and protect the lamps. The colors of these lenses serve to distinguish different classes of subscribers. Ten lamp jacks together form a lamp strip.

In the Munich installation four-volt lamps are used thruout with the sole exception of the lamps which indicate

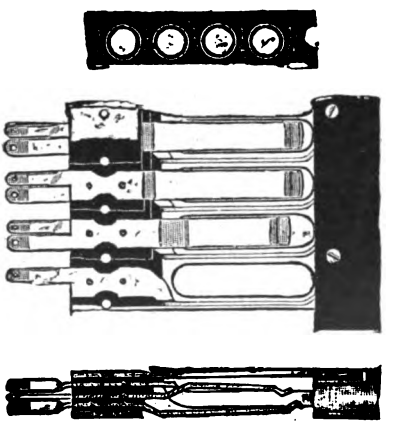

FIG. 7.—JACKS ON SUBSCRIBER BOARD.

whether the service wires between the two exchanges are engaged or not; these require twenty-four volts. The normal four-volt lamps (*a*, Fig. 4) take about

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0.3 ampere, the somewhat larger control lamps (*b*, Fig. 4) 0.5, and the twenty-four-volt lamps 0.1 ampere. The renewals of lamps average 1.6 per day. The subscribers' calling relays (Fig. 5) have two coils; the main coil of about five hundred ohms is connected with the subscribers' line; the local retaining coil of twenty ohms keeps the armature attracted until the coil is attended to. This relay is extremely sensitive, the magnetic resistance being made as good as possible. Each relay is enclosed in a brass case so as to be dust and fire proof. With each call relay is associated a cut-off relay, the function of which is to cut out the main coil of the former when a plug is inserted in the line jacks, and to break the circuit of the retaining coil. Its resistance is about twenty ohms.

The clearing signal relays only differ from the call relays in being enclosed in copper cases. All the other relays, such as the control relay, the night alarm relay, etc., are constructed like the call relay, and only differ from it in the method of winding the coils.

The jacks of the trunk junction board (Fig. 6) are break-jacks, with platinum contacts, and the "engaged" test is made in the usual way.

The jacks of the subscribers' board (Fig. 7) consist simply of two springs and a socket. The springs are not normally in a state of tension and are not connected with the battery until a plug is inserted.

The plugs are made up of three parts and are connected in the ordinary manner.

The multiple jack strips are connected with each other by means of sixty-three-wire cables, having conductors 0.6 mm. in diameter, insulated with silk and wool. The insulation resistance and the capacity of these cables are from 150-250 megohms and 0.1-0.125 microfarads per mile respectively.

THE METRIC SYSTEM.

The metric system is based on the meter, which, according to the United States Coast and Geodetic Survey report of 1884, is equal to 39.370432 inches. The value commonly used is 39.37 inches, and is authorized by the United States Government.

There are three principal units — the meter, the liter (pronounced lee-ter) and the gram, the units of length, capacity and weight respectively. Multiples of these units are obtained by prefixing to the names of the principal units the Greek words deka (10), hekto (100) and kilo (1,000); the sub-multiples, or divisions, are obtained by prefixing the Latin words deci (1-10), centi (1-100) and mili (1-1,000). These prefixes form the key of the entire system. In the following tables the abbreviations of the principal units of these submultiples begin with a small letter, while those of the multiples begin with a capital letter. They should always be written as here printed.

MEASURES OF LENGTH.

10 millimeters (mm.) = 1 centimeter (cm.)
10 centimeters = 1 decimeter (dm.)
10 decimeters = 1 meter (m.)
10 meters = 1 dekameter (Dm.)
10 dekameters = 1 hektometer (Hm.)
10 hektometers = 1 kilometer (Km.)

MEASURES OF SURFACE (NOT LAND).

100 sq. millimeters (mm2) = 1 sq. centimeter (cm2.)
100 sq. centimeters = 1 sq. decimeter (dm2.)
100 sq. decimeters = 1 sq. meter (m2.)

MEASURES OF VOLUME.

1,000 cu. millimeters (mm3) = 1 cu. centimeter (cm3.)
1,000 cu. centimeters = 1 cu. decimeter (dm3.)
1,000 cu. decimeters = 1 cu. meter (m3.)

MEASURES OF CAPACITY.

10 milliliters (ml.) = 1 centiliter (cl.)
10 centiliters = 1 deciliter (dl.)
10 deciliters = 1 liter (l.)
10 liters = 1 dekaliter (Dl.)
10 dekaliters = 1 hektoliter (Hl.)
10 hektoliters = 1 kiloliter (Kl.)

NOTE.—The liter is equal to the volume occupied by one cubic decimeter of pure distilled water at its maximum density, or 39.2 degrees Fahr.

MEASURES OF WEIGHT.

10 milligrams (mg.) = 1 centigram (cg.)
10 centigrams = 1 decigram (dg.)
10 decigrams = 1 gram (g.)
10 grams = 1 dekagram (Dg.)
10 dekagrams = 1 hektogram (Hg.)
10 hektograms = 1 kilogram (Kg.)
1,000 kilograms = 1 ton (T.)

NOTE.—The gram is the weight of one cubic centimeter of pure distilled water at a temperature of 39.2 degrees Fahr.; the kilogram is the weight of one liter of water; the ton is the weight of one cubic meter of water.

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EDUCATIONAL COURSE IN TELEPHONY.

BY A. J. KUSEL.

A chemical reaction in the bichromate cell results in the formation of chromic acid, for when a solution of bichromate of potassium is treated with sulphuric acid a purely chemical action takes place and the result is the formation of chromic acid. The chromic acid prevents depolarization by the oxidation of hydrogen. The original solution of Bunsen is as follows:

Bichromate of potassium.....77.5 grams
Sulphuric acid.....78.5 c. c.
Water .....750 c. c.

The bichromate must first be dissolved by heating the water to boiling point. The bichromate crystals should first be crushed and then added to the water. This solution should then be set aside and allowed to cool. After it has cooled the acid may be added slowly. The acid should be added to the water, and in no case the water to the acid. It is never to an advantage to have too much acid. It is always better to add a little acid from time to time. This will give the cell a much longer life than if the solution was at first strong in acid.

THE FULLER BICHROMATE CELL.—The special object in the design of the Fuller battery is the continuous amalgamation of the zinc. It is shown in section, Fig. 18. The zinc, to which a copper wire, rubber-covered, is attached, is then placed in a porous cup with an ounce of mercury. The cup is then filled with water, and is placed in the glass jar containing the solution of bichromate and acid and carbon plate. The acid diffuses through the porous cup fast enough to act continuously on the zinc, which has enough mercury surrounding it to keep it well amalgamated.

CHROMIC ACID AS THE DEPOLARIZER. Since one molecule of a bichromate furnishes two of chromic acid, it will readily be seen that ten-thirteenths as much powdered chromic acid is required as sodium bichromate. The amount of sulphuric acid is only slightly less. The initial E. M. F. is two volts.

Another modification, known as the Ward and Sloane battery, employs zinc in caustic soda and carbon in a mixture of chromic acid, nitric acid and common salt. The proportions are as follows: To one half-gallon of nitric acid add one and a half pounds of chromic acid and one pound of salt. This makes one charge for the porous cup of a cell 12 by 12 by 9 inches. The zincs are the equivalent of twenty-four rods half an inch in diameter, and the carbons are equivalent to fifty electric light carbons. The initial E. M. F. is 2.9 volts. Such a cell has an internal resistance of one-tenth ohm, and will give a current of ten amperes for thirty hours; final E. M. F. 2.3 volts.

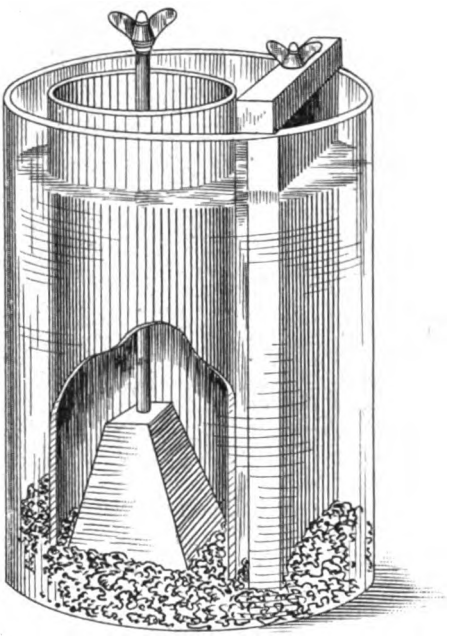

FIG. 18.

The following is the solution recommended for the cell:

Nitric acid (density 1.42)...1 part by weight
Chromic acid .....3 parts " "
Sulphuric acid.....6 " "
Water .....5 " "

The chromic acid is first dissolved in the water; the nitric acid is then added, and finally the sulphuric.

This solution requires ten parts of acid to five of water. It is scarcely possible to avoid wasteful local action with even well-amalgamated zinc in such a concentrated acid solution.

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THE PARTZ ACID GRAVITY BATTERY. This zinc-carbon element possesses several points of novelty and excellent qualities under appropriate tests. It is, in

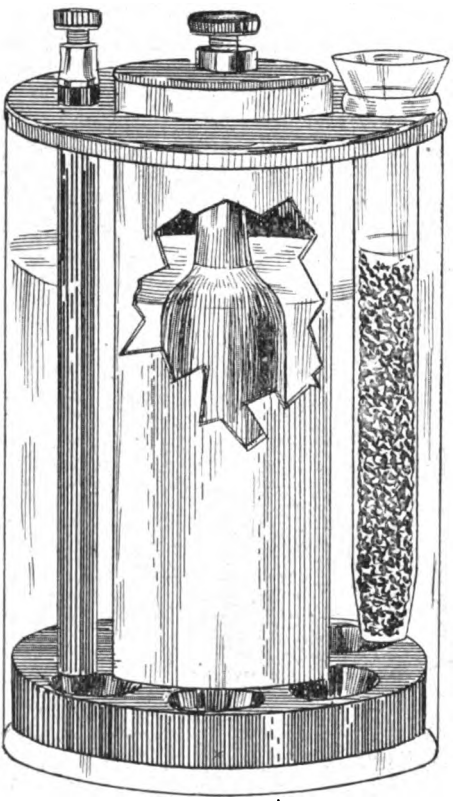

FIG. 19.

fact, the application of the gravity principle to an acid depolarizer. For this purpose a flat carbon plate, with surface increased by means of pointed cones, corrugations or holes, lies in the bottom of the cell; and a carbon rod, with the proper taper at the lower end to fit tightly into a hole in the plate made to receive it, leads to the positive terminal on top of the cell. The zinc is a heavy cylinder as shown (Fig. 19). In the former case the cup is paraffined to a height of two inches from the bottom to prevent entrance of the acid depolarizer.

The depolarizer is a sulpho-chromic salt, in which sulphuric acid has been caused to unite with chromic acid in an amorpho-crystalline state. It is supplied to the cell when everything else is in place, by filling into the vertical tube shown in the cut to the level of the liquid in the cell. The salt slowly dissolves and diffuses over the bottom so as to cover the carbon plate.

The excitant is either sulphate or magnesium or common salt. The internal resistance is somewhat lower with the latter.

Whenever the cell shows a tendency to weaken and fail, it is necessary only to add one or two tablespoonfuls of the sulpho-chromic salt through the tube to

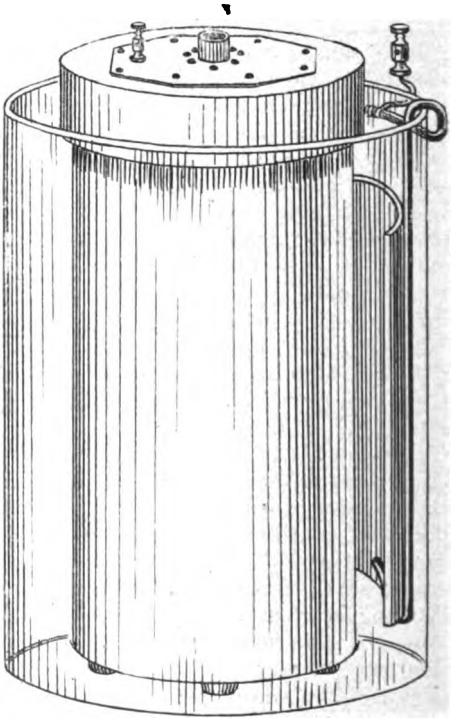

FIG. 20.

restore the current to its normal value. After the spent salts have accumulated to such an extent as to interfere with the working of the cell, it is better to turn out the contents, soak the carbon in warm water, amalgamate the zincs, and set up again with fresh solutions.

Since the depolarizer is intended to remain in the bottom of the cell, it is apparent that this battery must be left as much as possible undisturbed.

TAYLOR'S BATTERY.—This is a zinc-carbon element, capable of maintaining

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a very large current with small diminution of E. M. F. The carbon rods, eight in number, are attached to a wood cap (Fig. 20) and make contact with the brass plate shown on top. The zinc plate has a surface of 27.5 square inches, is thoroughly amalgamated, and is wholly immersed in the dilute sulphuric acid. Contact is made with the zinc plate by means of a heavily amalgamated copper wire. On account of the thoro amalgamation of the zinc, the loss due to local action on open circuit is small.

The initial E. M. F. is 1.9 volts, the current on the short circuit ten amperes, and the internal resistance 0.18 ohms. This cell weighs, charged, 10.5 pounds, with a capacity, it is claimed, of seventy ampere-hours.

The depolarizing solution consists of a saturated solution of potassic nitrate and sulphuric acid.

THE COPPER OXIDE BATTERY.— It has been remarked that, in general, the best depolarizers are liquid. There are, however, two exceptions which exhibit notable efficiency. They are the oxide of copper and the chloride of silver. Both of these solids readily gave up their non-metallic element to nascent hydrogen, and by reduction to the metallic state became excellent conductors.

The copper oxide cell appears to have been introduced by Lalande and Chaperon, and one of the forms that was shown in Fig. 21. The spiral of zinc is immersed in a solution of caustic potash or caustic soda, thirty or forty parts to one hundred of water. The upper vertical part of the zinc, where it passes out of the solution, is covered with a caoutchouc tube to prevent local action at that point. The negative consists of a cup of sheet iron containing the copper oxide. To this cup is riveted an insulated copper wire which passes up thru the cover and forms the positive electrode. To prevent action upon the alkaline solution by the carbonic gas of the air, it is covered with a thin layer of petroleum oil. A disadvantage is that only a part of the iron surface, constituting the negative plate, is provided with the empiric oxide sufficiently near to be of any service in the removal of the hydrogen, which accumulates on all portions of the inner metallic surface. The reduced copper, too, is not in good contact with the surface of the iron cell. The conversion of the alkali into a carbonate by absorption of carbon dioxide from the air, necessitates the closing of the cells against admission of the air, or else the use of the heavy petroleum oil. The larger cell is closed and has a relief valve of rubber tubing.

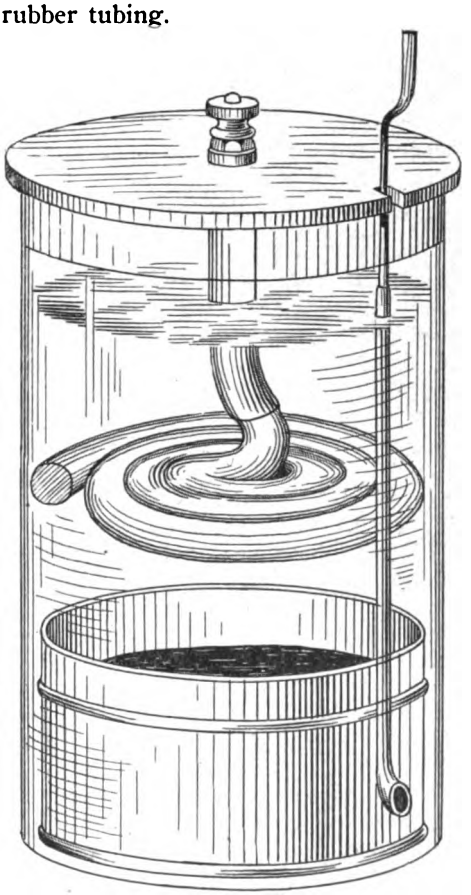

FIG. 21.

Zinc displaces hydrogen from the caustic alkali, forming sodium (or potassium) zincate; while the ejected hydrogen, traveling with the current, arrives at the cupric oxide, from which it abstracts oxygen, and the metallic copper is thus reduced at or near the iron of the cell.

THE EDISON-LALANDE BATTERY.— Edison has devised a form designed to

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meet the objections noted above. The copper oxide is employed in the form of a compressed slab, which, with its connecting copper support, serves also as the negative plate.

Two of these plates are enclosed in a copper frame, on the longer arm of which is the binding post. A hard rubber safety plug in the middle prevents the zinc plate on either side from making contact with the copper oxide supporting frame. One, two or three of these copper oxide plates are used, according to the size and capacity of the cells. The weight of the oxide plate for a fifteen ampere-hour cell is two ounces, and for a three hundred ampere-hour cell two pounds.

Figure 22 is a three hundred ampere-hour cell complete. The cover is porcelain, with small openings for the zinc and copper terminals. Since this cover does not exclude the air, the formation of a carbonate is prevented by pouring on top of the solution of caustic potash a small quantity of heavy paraffin oil, so as to form a layer about one-fourth of an inch deep. It is of vital importance that this oil should not be omitted. If it is not used the life of the cell is reduced fully two-thirds.

If the cell is required to furnish a strong current at once, it should be short-circuited for ten or fifteen minutes the first time it is used. By this means enough metallic copper is reduced to form a good conducting surface, and the internal resistance of the cell falls to its normal working value. Subsequent short-circuiting should, of course, be avoided, especially because the internal resistance is very low and the large current flowing causes a great waste of material in the cell.

The three hundred ampere-hour cell shown is 11½ inches high and 5⅜ inches in diameter. Its internal resistance is about 0.03 ohm, and its working E. M. F. about 0.7 volt. It is capable of delivering fourteen amperes. On open circuit there is practically no local action.

The zinc should be well amalgamated.

Pressed copper oxide plates have also been used abroad in a cell, having the form of Fig. 23, in which the compressed plates B are held in contact with the sheet iron A by rubber bands. The cell is closed to prevent entrance of air, but has a relief valve H for the escape of accumulated gas. The small zinc surface V means relatively large internal resistance. The plates are made by

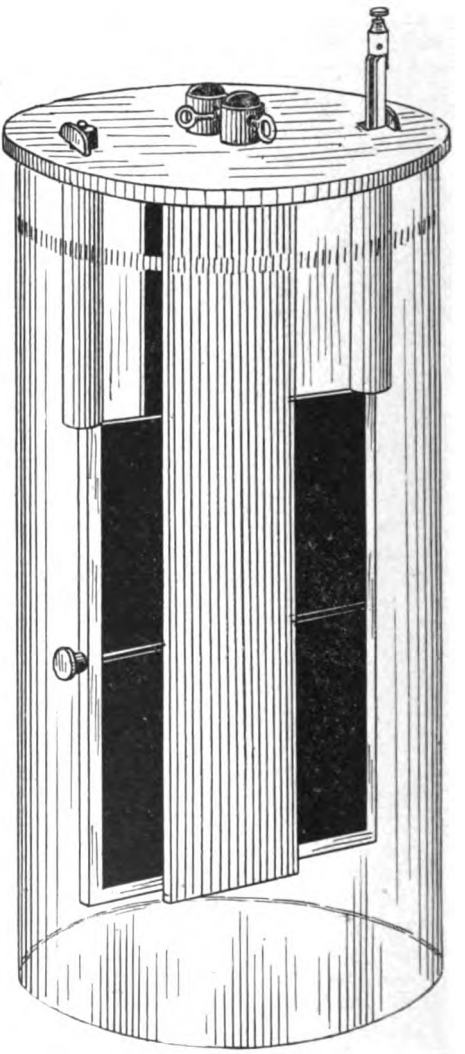

FIG. 22.

mixing copper oxide with from five to ten per cent of magnesium chloride, and heating the thick mass in an iron mold.

This about closes the list of close-circuit batteries. There are a number of others, of course, which may be used for laboratory use, but the batteries

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which have been taken up are those which will be met with in actual practice. The fundamental principle of each battery has been laid out so one should

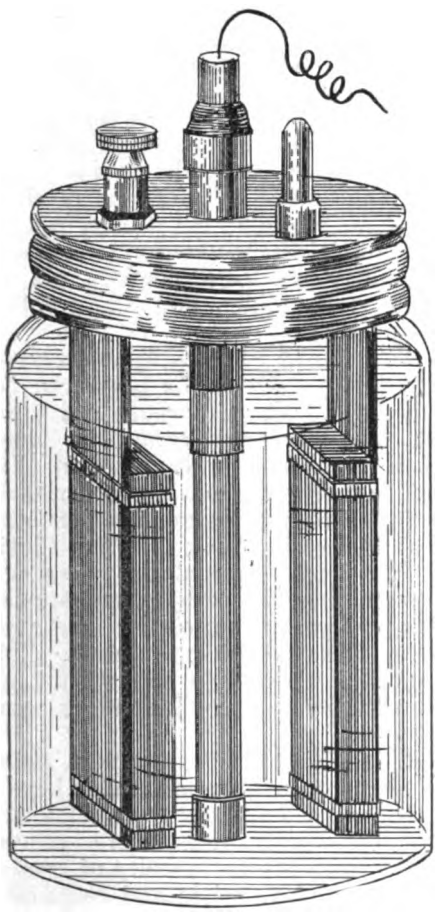

FIG. 23.

have no trouble in locating or remedying any battery fault of the closed-circuit type. The batteries most met with in telephone service are of the open-circuit type, so leaving the closed circuit we will take up open circuit batteries.

First at the head of the list stands the Leclanché cell. The Leclanché cell, Fig. 24, as may be seen, has a porous cup. This porous cup has a carbon rod on the inside of it, and is filled with manganese dioxide packed in the porous cup, which is sealed with a tar cement, with a small vent tube.

The size of the zinc rod, which never exceeds half an inch (1.25 cm.) in diameter, indicates large internal resistance, and shows that this cell is designed to furnish only small currents thru considerable external resistance. The amount of energy held potentially in the cell is represented approximately by the weight of the zinc.

The exciting liquid is sal-ammoniac. To set up the cell, five or six ounces of sal-ammoniac are dissolved in water. Water, or water containing sal-ammoniac, is also poured into the porous cup thru one of the vent tubes. If water alone is added, the cell must stand for about twenty-four hours before use, to permit the diffusion of the ammonium salt thru the porous cup.

An advantage of this cell is that the diffusion of the liquid thru the porous vessel, which serves only to hold the depolarizer and the broken carbon, is of positive utility; while in two fluid cells

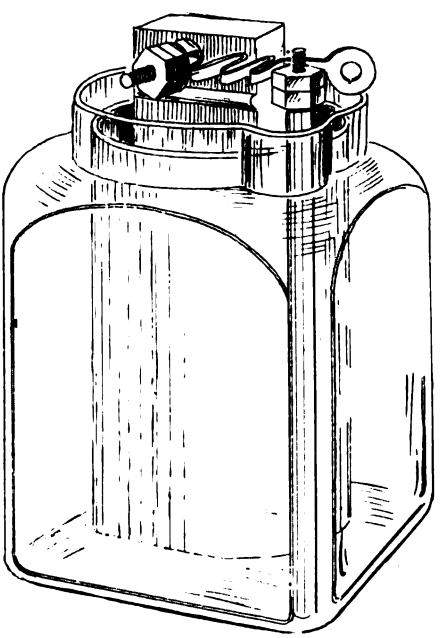

FIG. 24.

the diffusion of the two liquids thru the pores is an undesirable feature.

The initial E. M. F. of the Leclanché cell varies from 1.4 to 1.7 volts, and the internal resistance from about 0.4 to 2 ohms.

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CHEMICAL REACTIONS IN THE LECLANCHE CELL.—Theoretically, no chemical reactions take place so long as the circuit remains open, as the cell contains neither acid nor an acid salt. But when the circuit is closed, zinc displaces ammonium with the ammoniac chloride, and the ammonium breaks up into ammonia gas, which is set free and escapes after the liquid becomes saturated, and hydrogen, which is oxidized by the manganese dioxide.

If the liquid is allowed to become supersaturated by evaporation, a double salt of the chlorides of zinc and ammonium is liable to crystallize on the zinc. This reduces the E. M. F. and increases the internal resistance. A small quantity of hydrochloric acid will usually dissolve these crystals.

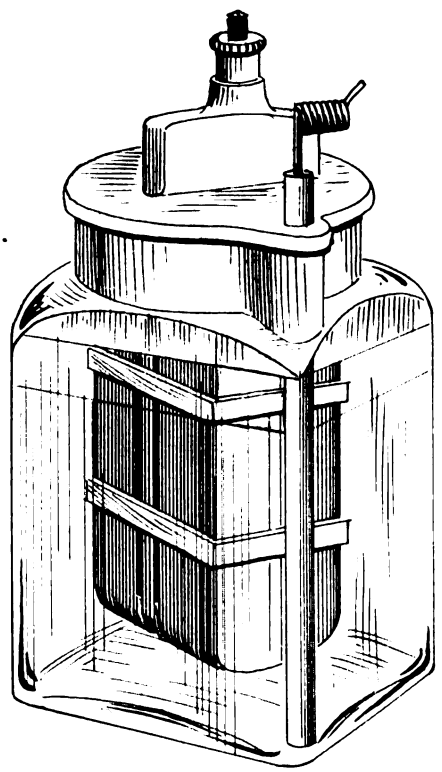

FIG. 25.

When a Leclanché cell is left undisturbed for some time, it will be found that the zinc rod is eaten away at the surface of the liquid, and that it is conical in shape, with the larger end of the cone at the bottom of the zinc. The waste at the surface is doubtless due to oxidation, but the coning is the result of a peculiar local action sometimes seen in other forms of battery.

The double chloride of zinc and ammonium gradually settles to the bottom of the cell, becoming progressively denser and denser as the bottom is approached. Now zinc in a solution of ammoniac chloride is positive to zinc in zinc chloride; if the latter liquid contains ammoniac chloride, the resulting E. M. F. is smaller, but still appreciable. Hence local circuits are formed between the upper and lower portions, playing the part of the zinc in a simple voltaic combination.

THE PRISM LECLANCHE BATTERY.—The prism form of the Leclanché cell was devised for the purpose of dispensing with the porous cup. The carbon plate is suspended from the cover (Fig. 25), and attached to it by rubber bands are the two agglomerated prisms, containing the depolarizer. They consist of forty parts granulated manganese dioxide, fifty-two parts granulated carbon, five parts gum shellac, and three parts acid potassium sulphate. The mixture is heated to 100° Cent., and then compressed in molds under a heavy pressure.

THE CLOSED LECLANCHE CELL.—When an open Leclanché cell is kept in a dry place the liquid evaporates, and the solution becomes more concentrated, with greater liability of crystallization at the surface and consequent creeping of the salts upward toward the top. To avoid this difficulty, closed cells (Fig. 26) have been used. In the former, the cover is wood saturated with paraffin and attached to the porous cup, but removable from the outer jar. So also the zinc is held loosely in the cover, and can be taken out. The cover fits down on a shoulder in the top of the jar, and a soft rubber ring makes it tight.

In the latter form the porous cup is made with a flange, which rests upon the top of the jar. Both the jar and the flange are paraffined, so that a close joint is made. The zinc passes thru an opening in the cell specially provided

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for it. This is made tight by a piece of soft rubber tubing enclosing the rod at the point where it passes into the jar.

Two or three other modifications of details may be noted in these cells. The porous cup, which is unusually large, has in the bottom three large holes covered with burlap. When the cell is set up, the sal-ammoniac solution enters at once, and the cell is ready for use.

The porous cup has a small hole in the bottom to admit the liquid, and two

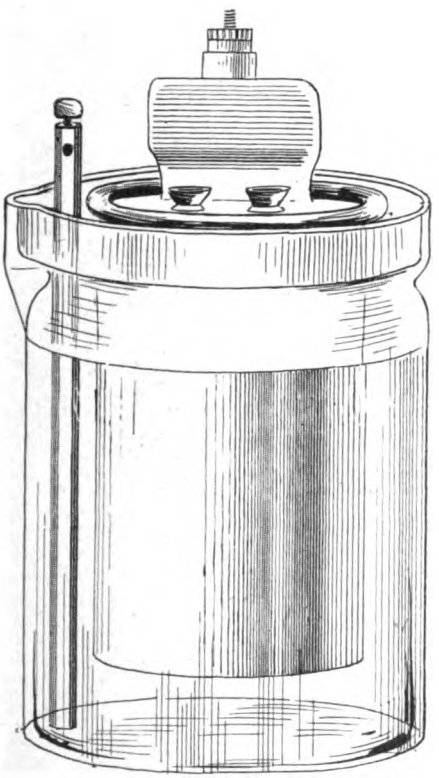

FIG. 26.

holes shown in the cut, on either side of the carbon at the top. The carbon has a special connection by means of a bolt and lock-nuts, which serve their purpose satisfactorily.

A stop in the bottom of the glass jar prevents contact between the zinc and the porous cup. The two water marks on the jar serve as a convenient guide in filling. Each cell requires four ounces or 120 grams, of sal-ammoniac.

Both of these types of batteries show an unusually high E. M. F., and have done excellent service in the hands of the writer.

LECLANCHE CELLS WITH CARBON CUP.— It is entirely practicable to dispense with the unglazed porous cup, and

FIG. 27.

to make a carbon cylinder serve as a receptacle for the manganese dioxide. Two such cells are represented in Figs. 27 and 28. Both of these are loosely covered, to prevent evaporation, and have the depolarizer enclosed by carbon. The zinc of the latter is a cylinder, and the carbon cup is corrugated to secure a larger surface. Both the polarization and recovery of these cells are not so rapid as in other forms of Leclanché cells, but they are more nearly continuous or uniform. A marked feature is the low internal resistance. It is only slightly over 0.3 ohm, and is no lower in the second than in the first, tho the zinc cylinder has so much larger surface than the rod. The intervening distance is greater, thus offsetting the larger surface.

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With an external resistance of five ohms, the loss of potential in the interior of these cells is only 0.07, or 0.08 of a volt, or about five per cent of the total E. M. F. of the cell.

FIG. 28.

In the cell shown in Fig. 29 the manganese dioxide appears to be incorporated with the carbon in the paste, and an agglomerate is thus produced by baking. The cell is effectively closed, and the zinc is insulated by a special glass sleeve passing thru the carbon cover. A lug on the zinc rod fits into a corresponding socket in the glass, and serves the double purpose of holding the zinc up from the bottom of the cell and preventing its turning round when the connecting wire is screwed fast to the negative terminal.

The agglomerated carbon cylinder has a long cleft on either side and the zinc rod hangs in the center. The glass insulator holds the zinc somewhat rigidly, and prevents any contact between it and the carbon.

ROBERT'S PEROXIDE BATTERY.—The elements are amalgamated zinc, carbon surrounded with an agglomerate of peroxide of lead, and a solution of chloride of sodium, to which is added a small quantity of bichromate of sodium. The E. M. F. is 1.8 volts.

The agglomerate is made by adding minimum (red lead) to powdered permanganate of potassium and hydrochloric acid, in quantity sufficient to form a liquid paste, by the combined action of the acid and the permanganate. The paste is then introduced into a mold, containing a carbon elec-

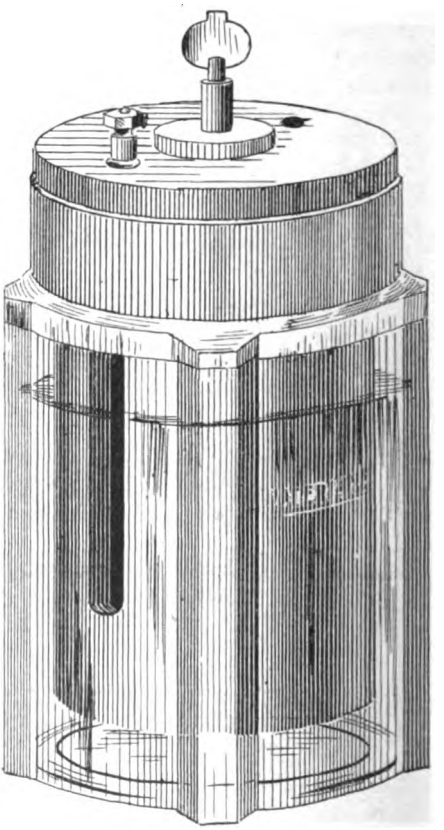

FIG. 29.

trode; and when, after a few minutes, it has set, it is withdrawn from the mold and dried at the temperature of the air. By this means a mass is obtained as dense as carbon.

The bichromate is added to the exciting liquid for the purpose of converting the chloride of lead in the agglomerate into an insoluble chromate. The partly soluble chloride would form a deposit of lead on the zinc.

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In the action of the battery, zinc displaces sodium with the production of zinc chloride and sodium hydrate. Hydrogen is released in the formation of the hydrate, and this abstracts oxygen from the lead peroxide.

The internal resistance of such cells is large on account of the presence of insoluble lead salts.

BATTERIES WITHOUT A DEPOLARIZER.

THE SMEE CELL.—The oldest battery of any practical value, without a depolarizer, is the Smee (Fig. 30). The positive plates of this cell are zinc, enclosing between them, with proper insulation, a negative of thin silver, corrugated and covered with platinum in a very finely divided state. The excitant, or electrolyte, is dilute sulphuric acid; and the purpose of the roughened surface of the silver is the mechanical dislodgment of the hydrogen as fast as it is released at the negative plate, since hydrogen is found to be much more easily detached from a rough surface than from a smooth one.

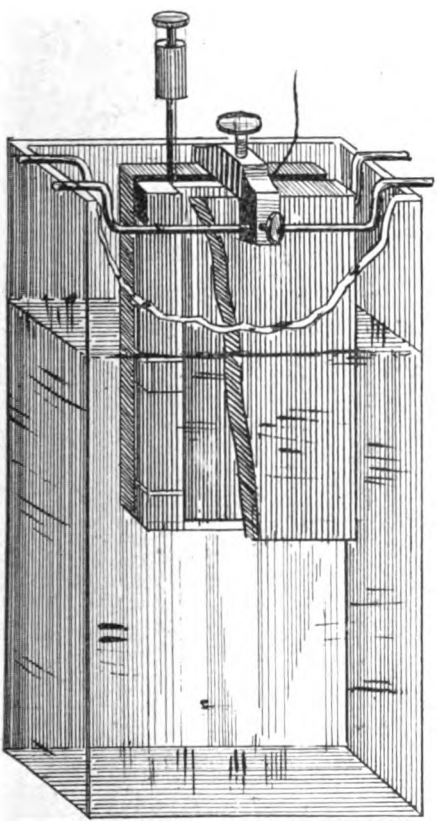

FIG. 30.

The silver plate may be prepared as follows: Obtain thick silver foil and roughen the surface lightly with fine glass paper, or by brushing over with strong nitric acid. Unless the surface is roughened the platinum black will not adhere. Connect the silver plate, by means of a copper wire, with a small slip of zinc, and insert the silver in a vessel of dilute acid, to which has been added a few drops of platinic chloride. The zinc slip should then be merely touched to the dilute acid at a point remote from the silver. The slight current thus produced will be sufficient to decompose the platinic chloride and the platinum will gradually deposit on the silver and color it. Then add more of the platinum salt, and insert the zinc deeper into the liquid. Gradually increase the current till the surface of the silver plate is covered with a black coating of finely divided platinum.

The platinic chloride may be prepared by dissolving scrap platinum in a mixture of two parts hydrochloric acid to one of nitric acid, and gently warming for some time. For the above use it is not necessary to drive off the acid or to crystallize the salt.

A negative plate for the Smee cell has been formed of copper, with the surface roughened by electro-deposition, then plated with silver, and finally platinized.

It is said, however, that the silver plating is liable to be porous, and that the acid in time works thru to the copper. Also, that the copper dissolves at the edges and is deposited again on the silver.

THE SEA SALT BATTERY.—A battery which is said to have done good service has been made with sea salt and powdered alum, in the ratio of five parts to two, dissolved in water, as the excitant. The elements were zinc and carbon, the latter having a very large surface. Zinc chloride and zinc sulphate are formed, and hydrogen is set free, with formation of sodium and potassium hydrates.

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Exactly what part the alum takes in the reactions is uncertain and obscure. But such cells are capable of intermittent service for certain classes of work requiring only small currents.

THE LAW BATTERY.— In this battery, and in others of similar design,

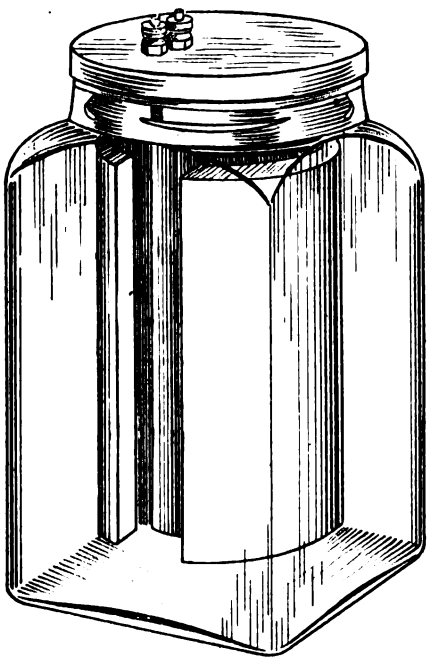

FIG. 31.

reliance is placed upon a large carbon surface to effect depolarization mechanically. The negative consists of a double cleft cylinder of carbon, with the zinc rod hanging well within the cleft (Fig. 31). The carbon has a surface of about one hundred and forty-five square inches, and the internal resistance is 0.4 ohm when the current flowing is 0.2 ampere. The cell is effectively closed by an insulating cover, so made that by a partial turn it locks down tightly against a soft rubber ring. The jar is of flint glass, annealed, and its capacity is one and one-third quarts, or one and a half liters. Sal-ammoniac is the excitant, and each cell takes five ounces of the salt.

A renewal of exhausted cell requires only a new zinc rod and a fresh solution of sal-ammoniac. The spent solution should always be thrown out, and the double carbon cylinder should be thoroly soaked in water and then exposed to the sun and air to remove the absorbed salts.

The cell is neat, clean, durable and efficient. For hard work it polarizes more continuously than a Leclanché cell, but for light currents the polarization is not sufficient to be noticeable. The initial E. M. F. is 1.37.

THE DIAMOND CARBON BATTERY.— The negative of this cell is composed of seven rods of soft carbon, 5.5 inches long and five-eighths of an inch in diameter, set into a soft metal top and secured by a set-screw, in the manner shown in Fig. 32. The metal top is cast round a porcelain insulator, thru which passes the zinc rod. The zinc is kept from falling too low by an iron

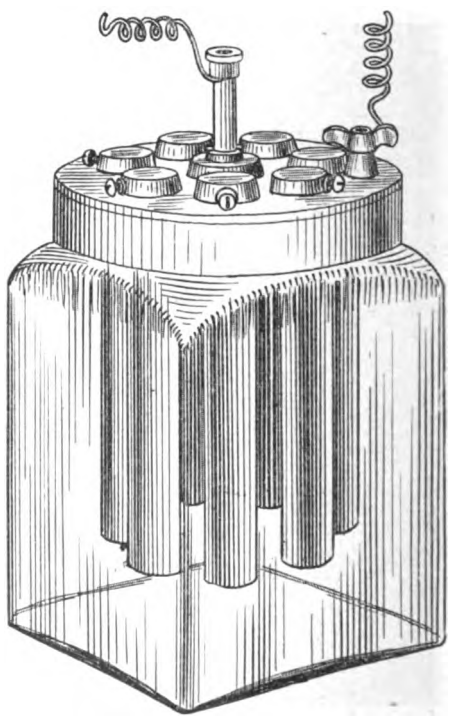

FIG. 32.

cross-pin, and a rubber ring closes the annular opening in the porcelain round the zinc. Another rubber ring at the bottom of the zinc prevents contact with the carbon. The tops of the cells are covered with paraffin or beeswax; the inside of the cover and the upper

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ends of the carbons are also paraffined. Care should be taken not to allow any of the solution of the sal-ammoniac to get on the cover, otherwise the crystallization and creeping of the salts produce a short circuit and the cell exhausts itself on apparently open circuit.

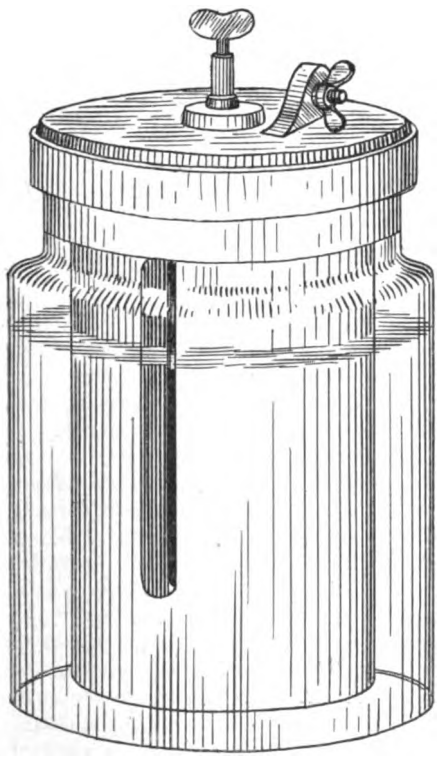

FIG. 33.

The internal resistance is only about 0.25 ohms, with five ohms external resistance; the polarization is continuous and progressive as in all cells of this class, but the recovery is very good. The initial E. M. F. is 1.36 to 1.39 volts.

CYLINDER CARBON BATTERIES.— In addition to the cylinder carbon battery already described, attention may be drawn to Fig. 33. The carbon cylinder and cover of the jar are made in one piece, and the cylinder in both is cleft for free diffusion of the sal-ammoniac solution. The oval form of the Laclede has no advantage except increased carbon surface. The connection with the binding post is made in both cases in such a way as to render corrosion by capillary ascent of the liquid quite remote. A greater danger in all these cells arises from careless handling after they are set up, during which the liquid splashes up against the top and over the porcelain insulating the zinc. The initial E. M. F. of all carbon cells without depolarizer is about the same, between 1.3 and 1.4 volts. They quickly drop below this value with a current of two-tenths of an ampere, and, subsequently, rise but little above a single volt. The ease and cheapness with which they may be restored to nearly their initial efficiency after exhaustion, constitute a strong commendation in their favor.

ACTION OF AIR UPON THE PRECEDING BATTERIES.—From various experiments made with carbon-electrode and sal-ammoniac batteries, the following conclusions may be drawn:

(1) The surface of the carbon should be as large as possible, compared to that of the zinc; and by increasing the mass of carbon according to a given quantity of zinc, polarization may be suppressed.

A part of the carbon should be exposed to the air; for it has been proved that when the carbon is totally immersed the intensity is diminished, but recovers as soon as some of the liquid has been taken out. That is what a French physicist calls letting the carbon breathe. The use of porous jars which overreach the top of the glass jar is very important.

Preference should be given to gas-retort carbon, on account of its porosity, and, as we said in speaking of the chemical action in Volta's battery, it must be used in fragments large enough to permit the access of air. The powdered cake, formerly used, should be discarded.

These conclusions will be readily admitted by the reader, who can understand that the presence of oxygen in the pores of the carbon contributes to the depolarization of the battery. It is possible that the particular faculty of the carbon for absorbing gases in large quantities here plays some part, and that the properties of the gases thus condensed in the pores of the carbon may be different from what they were under ordinary circumstances.

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CHEMICAL ACTION IN SAL-AMMONIAC BATTERIES.

A French chemist, in analyzing crystals formed in sal-ammoniac batteries, found this formula for them:

The gases given off from the element were found to be:

One-half volume of hydrogen.

One-third volume of nitrogen and carbonic acid.

One-sixth volume of heavy carburetted hydrogen.

These results only confirm that which we have said above of the complicated composition of bodies formed in batteries.

ADVANTAGES OF THE SAL-AMMONIAC BATTERY.

This battery presents many advantages, which we will enumerate:

The zinc is not attacked by the sal-ammoniac. There is no chemical action in the battery while the circuit is open, or, in other words, there is no waste of material as long as there is no outside current produced. We have already spoken in detail upon this point in the description of sal-ammoniac batteries (single liquid); and we would only say that, from a practical point of view, this peculiarity constitutes an incontestable superiority of the Leclanché battery over that of Daniell.

On account of the depolarizing action of the peroxide of manganese, the electromotive force at first starting of this cell is, as given by Leclanché himself, 1.38 (Daniell's cell taken as a unit). It has indeed always been possible to replace, in the telegraph and analogous applications, a certain number of peroxide of manganese cells. Leclanché states that twenty-four of his cells can replace forty of Daniell's.

This battery has but a comparatively feeble resistance, resulting from the conductivity of the peroxide of manganese and of the carbon, and also from the considerable mass of the conductive electrode. In the model, in which the porous jars are 5½ inches high, the resistance is between 5½ and 6 units.

With equal dimensions the Leclanché has less resistance than the Daniell, which constitutes still another superiority.

It is evident that if the zinc, instead of being a rod half an inch in diameter, were rolled in the form of a cylinder surrounding the porous jar, as in the usual disposition of batteries, the resistance of the cell would be still less. As there is no consumption of zinc while the circuit is open, there is no inconvenience in increasing its surface. Consequently there is a means of reducing the resistance of a Leclanché cell, if in any particular instance it might be of advantage.

We will give, further on, the reasons which determined Leclanché in the choice of the dimensions given to the soluble electrode.

The battery contains no poisonous substances, neither does it throw off any acid vapors nor any appreciable odor.

The first cost of materials is comparatively small.

The battery resists intense cold without freezing, and consequently without ceasing to work, which is proved by the following experiment:

A freezing mixture, at 25° Cent., was placed around a Leclanché cell, in which the thermometer finally descended to 16° Cent., without causing any appreciable slackening in the movement of an electric bell upon which the cell worked. The cell was shaken, or left perfectly still, and in neither instance was any weakening (with this summary means of comparison) or tendency to freeze, observed.

This battery presents, in this respect, still another notable advantage over the Daniell, which freezes in France during severe winters. The direct experiment shows that a saturated solution of sulphate of copper freezes at 5° Cent., and a concentrated solution of sulphate of zinc at 7° Cent.

A publication of Leclanché states that the resistance of his cell varies from 2.33 units at + 10° Cent. to 4.22 units at — 18° Cent., whereas that of the Daniell increases from 8.35 at + 10° Cent. to 12.58 at 0° Cent., and to 14.00 at — 4° Cent. If the temperature continues to lower, at — 6° Cent. the liquids become pasty, and toward —

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20° Cent. the resistance reaches 200 units.

All this goes to show that the Leclanché battery never freezes, and that it should be used in preference to all others in all northern countries.

These advantages are of great practical importance, and explain the success of this battery, which is today the most extensively used for telegraphs, electric bells, and other analogous applications of electricity.

Any number of these cells may be prepared in advance and stored away without putting the liquid in them, ready for use at any moment.

After having been charged, they may be left a long time without much evaporation of the liquid and without any consumption of the materials. Their form facilitates transportation, and is capable of being modified, as will be seen, in order to obtain a perfectly closed battery. No care is needed for months at a time; it depends, of course, upon the activity of the work to be done.

The cell furnishes a more intense current than a Daniell of the same size, and almost as intense as one of Marie Davy's cells.

One must be careful, however, not to use this battery for purposes to which it is not fitted; for instance, when a continuous current or a great quantity of electricity is desired.

CONSTRUCTION AND USE.

We have had occasion to speak of the advantages of rolled zinc over cast zinc; we add that drawn zinc is better than either, as it is more dense and the pores are less open. Little scales are sometimes seen to detach themselves from the rolled zinc, which denotes some irregular action of the liquids upon the metal. There is nothing of the kind apparent with the drawn zinc, undoubtedly because it is more homogeneous.

We have fully explained why, in single liquid batteries, there is an advantage in giving a greater surface to the conducting electrode than to the soluble electrode. The same reasons hold good for imperfectly depolarized batteries, such as that of Leclanché; it is seen how the inventor reduced the zinc to a small rod. We will again have occasion to speak of the dimensions of the electrode, which is quite a delicate and important question.

Leclanché, in recommending amalgamation of the zinc, says: "In this battery, where there is no acid, the zinc should be used according to the theory, without amalgamation. But while the battery is at work the attack upon the zinc roughens its surface, thus facilitating the adherence of saline crystallizations when the temperature varies; whereas amalgamated zinc always presents a surface free from crystals, which fall to the bottom of the jar and do not diminish the conducting surface of zinc.

"It is very important to employ sal-ammoniac as pure as possible. That purified by sublimation is the best, altho a little costly. Very good, however, can be found which has not undergone this process of purification. Care should be taken that the sal-ammoniac be not dissolved in vessels of lead, for it would then contain several parts of chloride or of sulphate of lead.

"This condition would cause the loss of the principal advantage of the battery; for a local cell (zinc lead) would soon form which would produce a constant and rapid waste of the zinc and sal-ammoniac.

"It is best to use an almost saturated solution; there is, indeed, no inconvenience in putting a little more salt than is necessary in the jar; it will dissolve in proportion as it is consumed by the action of the battery.

"By the action of the battery salts are formed, and notably oxychloride of zinc, which is more easily dissolved in a saturated solution than in a weaker one; there is therefore an advantage in using a saturated solution, and it should not be allowed to weaken. In effect, it can be understood that if oxychloride of zinc crystals attach themselves to the zinc, its active surface is reduced and the resistance of the battery increased; the intensity of the battery might thus be greatly diminished. If, however, too large a quantity of sal-ammoniac be added there will be the same result.

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This salt crystallizes upon the surface of the zinc and the resistance of the battery becomes considerable. There can be no doubt as to the truth of this way of explaining things; for if the zincs be cleaned, the resistance will be diminished and the intensity brought back to its normal value. This observation is of great practical importance, because employes of little instruction are very apt to attribute to the battery all the faults that arise in telegraph offices, without being able to distinguish the cause; they believe the battery to be weakened, and think to restore its energy by adding more sal-ammoniac; they create, in reality, the fault which they intend to correct."

The quality of the bioxide of manganese is also very important; that which gives the best results is the needle manganese; it is crystallized, silky, and presents a graphite appearance; if, in addition to these properties, it is hard, it possesses very great conductivity. To use it, all foreign materials must first be taken off; then it is crushed and finally sifted to get rid of the powder. An equal volume of crushed carbon is then added. The mixture thus obtained is a very good conductor of electricity.

It is very important not to use powdered bioxide of manganese. The results of experiments by Leclanché show that polarization would be five times greater in a cell containing fine powder than in a cell constructed after the manner indicated above with grains of a certain size.

The resistance of fine powder reaches 150 to 200 units; it is considerably greater than that of the liquid with which it is dampened; consequently the hydrogen, instead of distributing itself thruout the whole mass, goes straight to the carbon plate and is not absorbed. On the other hand, the resistance of the coarser powder, as recommended above, is from twelve to fifteen units inferior to that of the liquid of the battery, and consequently the hydrogen is distributed and absorbed in the whole mass.

The porous jar should only be half filled with the liquid. The inventor says that the drier the matter contained in the porous jar the better the conditions of conductivity and working.

It will be seen as we advance that, by following this order of ideas, he has greatly improved his battery.

There is an advantage in using very porous diaphragms, in order that the action may begin as soon as the liquid has been poured in.

The quality of the porous jars is also very important. It appears that those of Wedgewood, tho excellent for other batteries, are not worth anything in the Leclanché. The English have had a good deal of trouble with porous jars which chip off or burst by the solidification of the double salts of zinc and ammonium. Neither in France nor in Germany has any inconvenience of this kind arisen.

IDENTICAL ELECTRODE BATTERIES.

Hitherto in batteries we have always met with two distinct electrodes immersed in one or two liquids.

We desire to show that batteries may be composed which contain identical electrodes, provided these electrodes be immersed in two different liquids. The direction of the current will be determined because one of the liquids will attack its electrode more actively, and the other will attack its electrode less actively or not at all.

We will give a very simple example. In a jar put a saturated solution of sulphate of copper, and on top of this some acidulated water, or salt water, or pure water. Now if a copper plate be placed on end in this liquid, it will be attacked at the top and become charged with copper at the bottom. It is plain that we have there an element of copper, acidulated water, sulphate of copper and copper.

This experiment furnishes the explanation of how a drop of sulphate of copper thrown upon copper will produce an attack, the same as a drop of nitrate of silver upon a silver plate. It happens that, by difference of specific gravity, the more saturated solution falls to the bottom and the less charged solution rises to the top; consequently a current is produced which transfers the metal from one point to another.

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In order to have no action at all, the composition of the liquid ought to be the same thruout.

We thought it better to note these observations to show the reader that various phenomena not apparently electric can in reality only be explained by electro-chemistry.

REMARKS UPON SINGLE LIQUID BATTERIES.

It might be generally said by taking any two pieces of different metals, or a piece of metal and a piece of carbon, and immersing them in some liquid conductor of electricity, a battery could be made.

The more lively the action of the liquid upon the positive electrode (negative pole) the greater intensity the battery will possess; there will be no action upon the other electrodes, at least not during the passage of the current — that is, not while the exterior circuit is closed. The choice of this second electrode is, however, far from being a thing of indifference; the less the electrode is capable of being attacked by the liquid, the greater will be the intensity of the battery. That is the reason why platinum and carbon should be preferred, at least with sulphuric acid, nitric acid, and the other liquids of which we have spoken.

The electric action is the result, in reality, of the difference of two chemical actions, one of which takes place while the other is prevented; one of the electrodes is attacked, the other is preserved from the attack of the liquid (at least while the circuit is closed).

The more energetic the action upon the positive electrode and the less this action upon the negative electrode, the more developed will be the electric phenomenon. For instance, a zinc-acidulated water-iron battery has but little power; the action of the liquid upon both electrodes is very lively as long as the circuit is open; as soon as it is closed the action upon the iron is stopped; but it reacts upon the attack of the zinc and diminishes it. If platinum be substituted for iron, the zinc alone is acted upon and the platinum remains unattacked before the circuit is closed; when the circuit is closed and the current flows, the action upon the zinc is hardly diminished.

THE GASSNER DRY BATTERY.—A large part of the most recent batteries appearing as candidates for public favor are of the so-called dry type. They contain the excitant in the form of a paste, the composition of which is in most cases a secret. Their convenience commends them to those having no technical knowledge relating to batteries, and they are very useful in situations precluding the use of unsealed cells with liquid electrolytes. But their store of available potential energy is, in general, smaller than that of batteries containing a larger quantity of fluid.

One of the oldest cells of the dry type is that of Dr. Gassner. The zinc composing the positive element is the containing vessel. It is usually covered with paper, or is enclosed in a paper box. The negative element is carbon, and it occupies about one-half the space in the cell.

The paste which is filled in between the zinc and the carbon in the Gassner cell is of the following composition: Oxide of zinc, one part, by weight; sal-ammoniac, one part, by weight; plaster, three parts, by weight; chloride of zinc, one part, by weight; water, two parts, by weight. The oxide of zinc in this composition loosens and makes it porous, and the porosity thus obtained facilitates the interchange of the gases and diminishes the tendency of the polarization of the electrodes.

The initial E. M. F. of this cell varies but little from 1.3 volts. It polarizes very rapidly on so low an external resistance as five ohms; while the internal resistance, which is different for cells of different size, is very irregular during the working of the cell, probably on account of the slow and irregular diffusion of the products of the chemical action.

Where the circuit is kept closed for short periods only, in such situations they will prove efficient and durable. Their convenience, particularly in the hands of unskilled persons, is much in their favor.

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Meserole's composition for a dry battery is the following:

Charcoal, three parts; mineral carbon or graphite, one part; peroxide of manganese, three parts; white arsenic oxide, one part; a mixture of glucose and dextrine or starch, one part; hydrate of lime, dry, one part; all by weight.

These are intimately mixed and worked into a paste of proper consistency, with a solution composed of equal parts of saturated solution of chloride of ammonium and common salt, to which are added one-tenth of the volume of a solution of bichloride of mercury and an equal volume of hydrochloric acid. The fluid is added to the dry mixture gradually, and the mass well worked together.

As storage batteries will be taken up in a later paper, all reference to them has been entirely omitted. The preceding battery paper will have covered all forms of battery pertaining to telephony. After a careful study of these papers, one should be thoroly familiar with batteries. The editor of these papers will be pleased to answer any questions pertaining to any part of the previous papers. The next paper will be on transmitters.

(To be continued.)

A CHINESE TELEPHONE EXCHANGE.

Some time ago we spoke of the Chinese telephone exchange in San Francisco. The following is a description of this interesting exchange:

"What is probably the most curious telephone office in the world is maintained by the San Francisco Telephone Company. This office is a branch and is located in the heart of San Francisco's extensive Chinese section. It was made necessary by the fact that the Pacific States & Sunset Telephone Company has more than two hundred and fifty Chinese subscribers in San Francisco, and, as many of these subscribers do not speak English at all, or at best imperfectly, the telephone girls who deal with the general public found themselves unable to cope with the foreign tongue. The result was the establishment of the Chinese exchange, by means of which all the Chinese business is handled. For instance, if you desire to talk with a Chinese silk merchant or with the courtly Chinese consul, Mr. Ho Yow, you call for 125 China, or whatever the number may be. Instantly a mellow voice with an oriental accent and a charming inability to pronounce the letter 'r,' answers you, and gives you, swiftly, and with never a mistake, the number desired. The principal stores in Chinatown, the restaurants and the clubs — mostly gambling resorts, it must be confessed — have the convenient telephone which aprises them of custom or gives warning of raids. All are individual lines and over most of them Chinese is spoken entirely.

"The manager of this unique branch of the system is Loo Kum Shu. He has six operators under him, all Chinese men — the only men employed as operators in San Francisco. The Chinese hello boys are Chin Soy Sing, Albert Bue, Bing Gey, Chin Li, Chin Sing and Wie Park. Three operators are on duty during the day and three during the evening, and one stays all night. The little Mongolian Mercury who carries the messages is Yick Chun. The custom of the Chinese requires that all visitors and customers who call to use the telephone must be entertained while waiting for the public telephone booths. Tea and tobacco are furnished at the company's expense for this purpose, and when the operators are not answering calls they are brewing scented cups of amber liquid.

"A change is shortly to be made in the Chinese station and then Chinese girls will be substituted for the male operators. The increasing volume of oriental business demands larger quarters, which have already been purchased, and the company finds that girl operators serve its purpose better than men. Every little while a difference of opinion between an operator and a subscriber is settled at arm's length out of office hours. This mode of arbitration disturbs the equilibrium of the service and never happens when the operator and the subscriber are of different sexes."

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WIRELESSNESS.

BY EDWARD J. WAKEMAN.

(*Continued.*)

The Belgian Government had put at the disposition of M. Guarini for three months the monument called the Colonne du Congrès at Brussels, the St. Rombaut tower at Malines, and the tower of Notre Dame at Antwerp.

The general plan was the following: In order to demonstrate that the repeater is an apparatus which will really work, it was necessary to prove that a transmitter placed at Brussels or Antwerp could *not* act direct upon a receiver placed at Antwerp or Brussels; that a transmitter placed at Brussels *could* act direct upon a receiver placed at Malines and vice versa; that a transmitter placed at Antwerp could act upon a receiver placed at Malines and vice versa; and that a repeater being placed at Malines, and the two extreme stations at Brussels and Antwerp being provided with the apparatus mentioned, Antwerp could receive the signals transmitted from Brussels and vice versa.

The communications were carried out strictly on the plan drawn up beforehand down to the smallest details, the watches particularly being carefully regulated. In the fourth case a Morse receiver had been added to the repeater, and after each test its paper strips were compared with the Morse signals of the end receiving station.

Attempts at Communication between Brussels and Antwerp.— Bamboos were securely fastened to the upper part of the monuments. The feelers were let down from these, in as upright a line as possible, at the useful parts — that is to say, those visible from one station to the other — and then obliquely, so as to enter the telegraph offices — in Brussels a house in the Rue Van der Meulen, and at Antwerp a hotel in the Place Verte. The useful part had a height of 27.50 m. (ninety feet) to the summit in each case. It consisted of a single cable of seven wires of 0.9 mm. for 17.50 m. (fifty-seven feet) of its length, plus a cylindrical part consisting of fifty parallel wires of 0.4 mm. and 10 cm. in height. The section of the cylinder was 50 cm. (twenty inches). At Brussels the cylindrical portion was at the upper part and at Antwerp it was at the lower part of the useful height; it served for receiving.

Each station was furnished with both transmitter and receiver. The latter instrument included a Morse receiver; the coherers used were of the metal-filing type; all the various models were tried, and the Blondel coherer was found to be the most sensitive. The transmitter included a Ruhmkorff coil giving a 25 cm. (say 10 inch) spark; the source of electrical energy was a battery of accumulators (16 volts); the current utilized was six to nine amperes. Both the energy of the accumulators and the sensitiveness of the receivers were carried to the maximum of which they were capable; this maximum corresponded, for the transmitters, to a current of nine amperes and a spark of 1.5 cm. (⅝ inch).

Of all the signals which were transmitted from Brussels in this first attempt, not one was received at Antwerp. It was the same with the signals transmitted from Antwerp, altho once when M. Guarini was able to raise the current to 10 amperes under exceptional conditions, it was possible to receive two signals at Brussels. After various tests, notably that made to make sure the passing of the electric tram in the Rue Royale was not affecting the coherer, it was recognized that these signals did indeed come from Antwerp. At the precise time that they were received, M. Guarini, after having removed the earth connection from the oscillator, produced two sparks of 10 cm. (4 inches) length and a duration of thirty seconds each.

This experiment was not carried further, the object desired by M. Guarini not being to discover the maximum distance to which he could establish wireless communication on land. The result was sufficient to assure us that by placing transmitters and receivers at any future time under the same normal conditions — nine-ampere current, 1.5 cm. (⅝-inch) spark, earth connection normal, Blondel extra-sensitive coherers, etc.— and keeping the same temporary installations, it was not possible to ob-

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tain direct wireless communication between Brussels and Antwerp. In the next part of the experiment, the feelers were placed in, if anything, less favorable conditions. But in any case the possibility is still reserved of cutting out the repeater with its feeler, and making certain by further test that, during this interruption, no signal could be exchanged between the two end stations.

Direct Communication between Brussels and Malines; (a) Brussels transmits, Malines receives.—The instruments at Brussels were the same as in experiment 1, and those at Malines were similar to those at Antwerp; they were installed at Malines at the Hotel Buda, situated opposite the cathedral.

The experiments gave rise to the following observations: (*a*) The earth connections having been removed from transmitter and receiver, all the signals sent were received; the current was four amperes, at a pressure of sixteen to seventeen volts. (*b*) A storm having blown down the feeler at Malines, this was placed so that the cylindrical portion was at the same height as the house roofs at Brussels; altho the height was still 40 m. (131 feet) at Malines, the communication was interrupted. (*c*) The feeler at Malines having been replaced by a single cable of seven strands of 1 mm. diameter, starting from the top of the tower, it was found necessary to bring the current up to six amperes to obtain communication. (*d*) The interlaced or stranded cable (lower part) of the feeler at Brussels having been replaced by a cable of seven strands of 1 mm. (strands placed alongside, but not interlaced or stranded), the communication was found to take place with three amperes only.

The whole of these results are in accordance with the theory of the upright feelers, which the present experimenters submitted in 1900 to the consideration of the Académie des Sciences — namely, that the electrical energy is radiated solely along planes normal (namely, at right angles) to its surface. The maximum effect is, therefore, obtained by using as the feeler a straight cylinder of a considerable height and considerable diameter, the feelers of the two stations being parallel and at the same height. Supposing them to be both of equal length, the planes of their bases ought to coincide and be normal to the generating parts of the cylinders.

(*b*) *Malines transmits, Brussels receives.*—At the beginning of this experiment a storm blew down the feeler at Brussels. On fixing it again, the cylinder of fifty wires was replaced by a cone of fifty wires, 0.4 mm., of the same height, the base, or widest part of the cone being upward. From this time forward, and until the end of the experiments, the feelers at Brussels remained as represented, the feelers at Malines

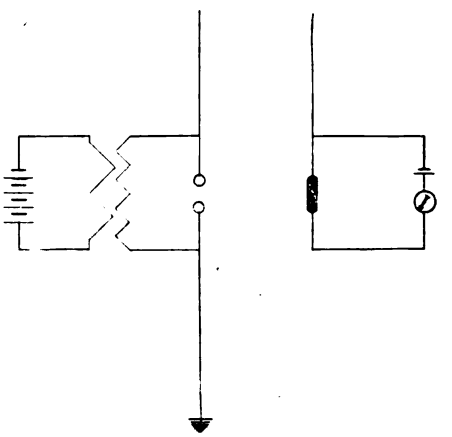

FIG. 1.

and Antwerp being exactly alike, formed from a single cable of seven strands of 1 mm.

The experiment 2B gave rise to the following observations: (*a*) In general the communication was not so good as in the preceding experiment 2A. At the beginning, only an occasional signal was received. This result is attributable, first, to the form of the feeler, the part serving as receiver — that is, the conical part — being not so satisfactory; further, it is due to the presence of several large metallic masses which ornament the Colonne du Congrès (a bronze statue of Leopold I., a metal handrail, four bronze statues ornamenting the stylobate, two bronze lions, etc.). A similar result has been already observed at Paris in the experi-

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ments undertaken between the Pantheon and the Eiffel Tower. No messages could be received at the latter station, while they were quite good at the Pantheon. This was attributed at the time to the enormous metallic body of the Eiffel Tower. (*b*) By working the transmitting and receiving instruments to the utmost, both of energy and sensitiveness, it was possible to establish a fair communication. The maximum number of signals were received when the vertical plane containing the two feelers were so arranged as not to encounter the buildings by which the apparatus was supported. (*c*) Different tests were made relative to earth connections. The best result was obtained with the arrangement shown in Fig. 1, in which there is no earth connection to the receiving instrument.

M. Guarini concludes from this that in wireless telegraphy the earth plays the part of large capacity.

Direct Communication between Malines and Antwerp; Malines transmits, Antwerp receives.— (*a*) Good results were obtained with a current of two to two and one-half amperes. (*b*) When reproducing the arrangement shown in Fig. 1, a less favorable result was obtained than in communicating the other way (2 B C). This does not weaken the opinion of M. Guarini as to the part played by the earth in wireless telegraphy, as at Brussels the receiving feeler was furnished with a large capacity on its upper part, the fifty-wire cone, and this capacity did not exist at Antwerp. (*c*) An interesting experiment was made with reference to the use of alternate currents in wireless telegraphy. The oscillator at Malines was disconnected, and the feeler was put to earth after having traversed the secondary of the Ruhmkorff coil; twenty-five per cent of the signals transmitted under these conditions were received at Antwerp. (*d*) A signal was received at Antwerp where the earth connection was removed, Malines using the alternate current.

B. *Antwerp transmits, Malines receives.*—(*a*) Less favorable results were obtained than in the opposite direction. A violent wind bent the feeler at Antwerp, and destroyed the parallelism between the two feelers. This is, therefore, a further corroboration of our theory of the part played by feelers. (*b*) Under the same atmospheric conditions the results obtained were better when alternate currents were used. (*c*) The results were still better when a capacity was added to the top of the transmitting feeler. (*d*) Marconi's tuning arrangement was tried. With complete discord, and altho the distance was greater than 2½ km. (1½ miles), the exchange of signals was carried on almost as well as with accord.

With respect to secrecy of wireless telegraphy, a telegram from Nice informs us that in spite of the precautions taken during the experiments at that time proceeding between Biot and Calvi, a telegram transmitted from Biot to Calvi was intercepted at Villefranche in its entire meaning and with perfect distinctness. This result confirms that of the Antwerp-Malines experiment.

Communication between Brussels and Antwerp, with use of Repeater at Malines.—The three preliminary experiments having given the desired results, M. Guarini could next undertake the definite experiment, which was to test the value of his automatic repeater, employed over a long distance. In the laboratory experiments it had always worked in a satisfactory manner. M. Guarini, however, wished to test it over a long distance, this apparatus being specially constructed for the purpose, when acted upon by waves much weakened by distance, of releasing a source of energy sufficiently powerful again to traverse a long distance. It should be stated at once that the experiment was crowned with the most brilliant success. On the last day the experiment was simply to note the time of passing of signals from station at Malines; and when, the experiment being finished, the Morse paper strip, at Malines, was placed side by side with that of the receiving station, it was seen that the two were absolutely identical. Not all the signals transmitted from the Brussels station arrived at Antwerp; but this latter station received absolutely all the signals passed on by Malines, which

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proved the strict fidelity of the repeater. And, indeed, the prime condition that an instrument should retransmit a signal is that it should have at least received it.

One feeler only was employed at Malines; it was connected to the Ruhmkorff coil. The commutator relay (switch relay) was for the purpose of maintaining or breaking its communication with the receiving parts of the apparatus, according as it was acting as receiver or as transmitter.

Various experiments led to the insertion of a transformer with a glass core and a condenser between the feeler and the coherer. It has been noticed that without this precaution the atmospheric electricity collected by the feeler at Malines, which was a real lightning conductor, acted upon the coherer at each interruption, so that once started off by a wave transmitted from Brussels or from Antwerp, the repeater went on acting without stopping. The switch relay was connected to a transformer by a well-insulated wire enclosed in an iron pipe, the latter being put to earth; it was recognized that lead pipes, even when of great thickness, allow the electric waves to pass thru. This wire was led into a metallic box, where it passed thru a self-induction coil, surrounded by crumpled tinfoil, put to earth; it ended at the primary of the transformer. The switch relay has a second object, which was to close the primary of the Ruhmkorff coil. Its sensitiveness was 1-20,000 ampere. The coherent which gave the best results was one made with large-sized filings of nickel, with traces of silver, enclosed in a space of 1 mm.; air was exhausted from the interior. To obtain an absolutely satisfactory coherer, M. Guarini made a special arrangement as follows: At the moment when the hammer gave the tap a supplementary resistance of 2,000 ohms was added to the resistance of 1,100 ohms, which had been already inserted in the coherer circuit. The repeater acted automatically, and in a perfectly satisfactory manner, both with alternate currents and with Hertzian currents.

The result of the Brussels-Malines-Antwerp experiments is that henceforth wireless telegraphy is possible upon land. Transmission was carried on direct between two stations at a distance of 22 km. (14 miles) under very unfavorable conditions; everything was against the experiments — the temporary nature of the installations, the violent snow-storms, ill-natured actions, notably at Antwerp, where M. Guarini was obliged to renew the feeler twice over. The distance of 22 km. (14 miles) was doubled by the use of an intermediate station, without any increase in the service staff being necessary, the Guarini repeater working automatically without loss of time in transmission, the message passing thru the relay station without stopping and with the velocity of light. The various results of these experiments, especially the successful use of alternate currents, provides the solution for a wireless telegraphy installation at low cost. Each station came to about $500, while the ordinary wire telegraph costs $220 per mile.

The use of the system in military and colonial matters will alone be dealt with here. There are numerous rapid means of communicating orders and information, for which whole armies of cyclists, horsemen, carrier pigeons and balloons are employed, as well as telephones and the ordinary telegraphs — electric, optic and acoustic. Now the use of any particular one of these systems to the exclusion of all others does not deal completely and surely with all the cases which may present themselves at time of war. A judicious choice of this or that system is necessary for this or that circumstance. It is therefore certain that the problem of communication must often remain unanswerable in wartime, no chief being in possession of the whole of these systems at the same time. The wireless electric telegraph luckily arrives to turn the flank of the difficulty. If the instruments employed are furnished with an arrangement which will in the first place not allow them to be acted upon by the enemy's instruments, and in the second will enable them to keep the secrecy of telegrams, that they are completed by the addition of the Guarini repeaters so as

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to reach any distance, then the wireless telegraph will assuredly henceforth replace all other systems wherever these have been found defective.

If we suppose the adoption of a complete network of repeaters thruout the whole extent of the territory, and if each repeater is provided with a Morse receiver, the Government could send out in a few minutes the order for mobilization and the places on the frontier in two or three minutes, and will be able to blazon forth to the whole country that it has been invaded.

Who does not know of the difficulties of every kind which are met with in the installation and maintenance of telegraph lines in uncivilized countries and of submarine cables? These absorb a large amount of expenditure. In case of a general international conflict, the telegraph service is assured only so long as it is used to the benefit of the nations possessing cables. In the colonies the telegraph lines are cut by the natives, destroyed by forest or bush fires; they require a very large staff for supervision; and lastly, expeditions at a distance are left to their own resources. If the wireless telegraphy apparatus had been known at the time of the North and South Pole expeditions, Andrée and De Gerlache would have remained in connection with the mother country, and the fate of Andrée would not have been left a cruel puzzle.

In such expeditions the use of a series of receivers is a necessity. But to assure us absolutely that a series of these repeaters will work just as well as one, and that the secrecy of signals is completely achieved by his sheathed metal feelers, M. Guarini owes us still one more effort. He must realize in practice the dual project which he has already worked out and planned, down to the smallest details, upon strictly scientific lines. Experiments are being carried on between Brussels, Ghent, Antwerp, Liège, Namur, Mons and Brussels, and these experiments are to serve as a preliminary for extended experiments between Paris and Brussels. M. Guarini intends to establish wireless communication between these two capitals, distant 275 km. (172 miles), by placing repeaters at Braine-le-Compte, Mons, Berlaimont, Wassigny, Moy, Concy-le-Château, Mitry, Villers-Cotterets and Betz — that is, with intermediate stations at intervals of about 27 km. M. Guarini can easily clear this distance of 27 km.; the Brussels-Malines-Antwerp experiments leave no doubt whatever on this point. But what he has to demonstrate in these further experiments is the efficacy of his sheathed feelers. If these experiments succeed, which every one will sincerely hope, a vast field opens itself out for the use of wireless telegraphy, as it will then be possible to have many applica-

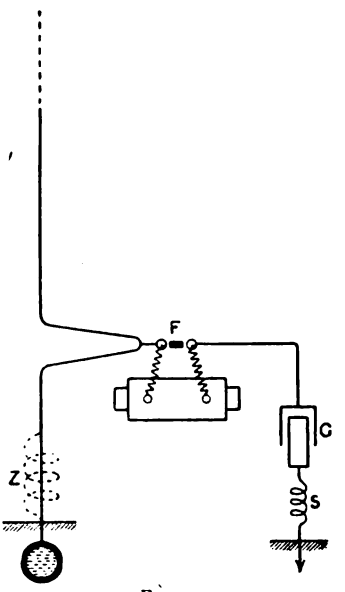

FIG. 2.

tions of overland telegraphy not yet realized and impossible of realization by the ordinary electric telegraph with wires.

Following is an extract from a lecture delivered at the forty-second general meeting of the Verein Deutscher Ingénieure, at Kiel, by Prof. A. Slaby:

THE LATEST PROGRESS IN SPARK TELEGRAPHY.

The latest form of connections of the wireless telegraph apparatus, made by the Allgemeine Elektricitäts Gesellschaft, are as follows: The transmitter (Fig. 2) consists of wire fastened to

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the flagstaff of the building, which is led to earth and connected to the water main. A loop in this wire is led thru the window into the room, and is connected to an induction coil, F, the other pole of whose secondary winding is connected to earth thru a tuned condenser, C. If we wish to telegraph with a greater wave length, it is only necessary to connect an additional coil, Z, in the earth wire, as shown by the dotted line. It corresponds to a certain equivalent length of wire by which we increase the quarter wave length, and a whole set of such coils can be employed. In each case, however, it is necessary to tune the oscillation produced in the circuit closed

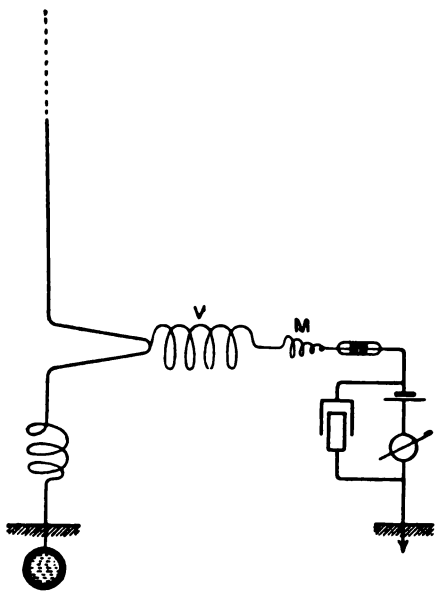

FIG. 3.

by the earth connection to the oscillation of the wire, in order to obtain the greatest effect. This is done in the simplest manner by adjusting an adjustable self-induction S, or the condenser C, which bear particular marks for this purpose.

A similar wire serves as the receiver (Fig. 3), to which, also, an extension wire in the form of an equivalent coil V is connected by means of the loop. The pressure is at its maximum at the end of the latter, and is strengthened by a tuned intensifying coil M, which is connected directly to the coherer. It is also possible to replace the action of the two coils by a single coil with corresponding winding. The earth connection of the coherer contains the dry cell and the relay, which are bridged by a condenser in order not to disturb the oscillations. The Allgemeine Elektrictäts Gesellschaft guarantees with this arrangement a tuning to the required wave length within certain limits, and a clear deciphering of signals at distances of 100 km. on the sea with masts fifty meters high.

Spark telegraphy has now left the condition of tentative experiment and has developed into actual engineering to accomplish a definite object, and the active forces of the industry will soon do what is needful to extend its sphere of applicability. It will, in the first instance, become an indispensable means of communication on the coast and on the open sea, where the life and property of mankind is most endangered, and I do not think it will be long before every large ship will be equipped with this simple and useful apparatus. But spark telegraphy will also, in the future, replace cable in many cases for submarine communication, altho in this respect we must not place our hopes too high. We can now almost see the limits, putting aside extravagant plans, as, for instance, elevating a wire one thousand meters by means of balloons, which may be possible in an individual experiment, but is worthless in practice for reliable continuous working. We can scarcely expect a transmission of signals of more than a few hundred kilometers, even with more perfect development of the means at present at hand.

The way open for further progress is also clear. The distance of transmission depends essentially on three things, the length of the parallel wires, the frequency of the pulsations, and the mean value of the current employed. The first two can hardly be increased, and also extending the length of the wire requires longer wave lengths and consequently slower frequency; and, therefore, quite a new means would have to be found to make the wave length independent of the length of wire employed. An increase of the induced current only remains, therefore. This depends on

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two quantities, the capacity or receptive power of the wire, and the actual pressure of the spark. The higher we take the wire the smaller will be the capacity of the parts distant from the earth, and the longer it is the harder it will be to secure it in stormy weather. Thus I hope to have shown that the future of spark telegraphy lies exclusively in the direction of producing higher electrical pressures. What we have used in this direction hitherto is very modest if we compare it with what has been shown to only a few of the initiated, far from here on the other side of the ocean, on the high Rocky Mountains at the sources of the Colorado River, by an investigator who has shut himself off from the world — Nikola Tesla. I can not report on it as an eye witness, but can only form my opinion from some photographs which he most kindly sent me a few days ago. Here (Fig. 4) one sees him in his lonely house, surrounded by artificially produced spark discharges, which throw into the shade all that our most daring fancy has dreamed of. May his theoretical knowledge and his eminent technical ability soon be placed at the practical service of spark telegraphy.

(To be continued.)

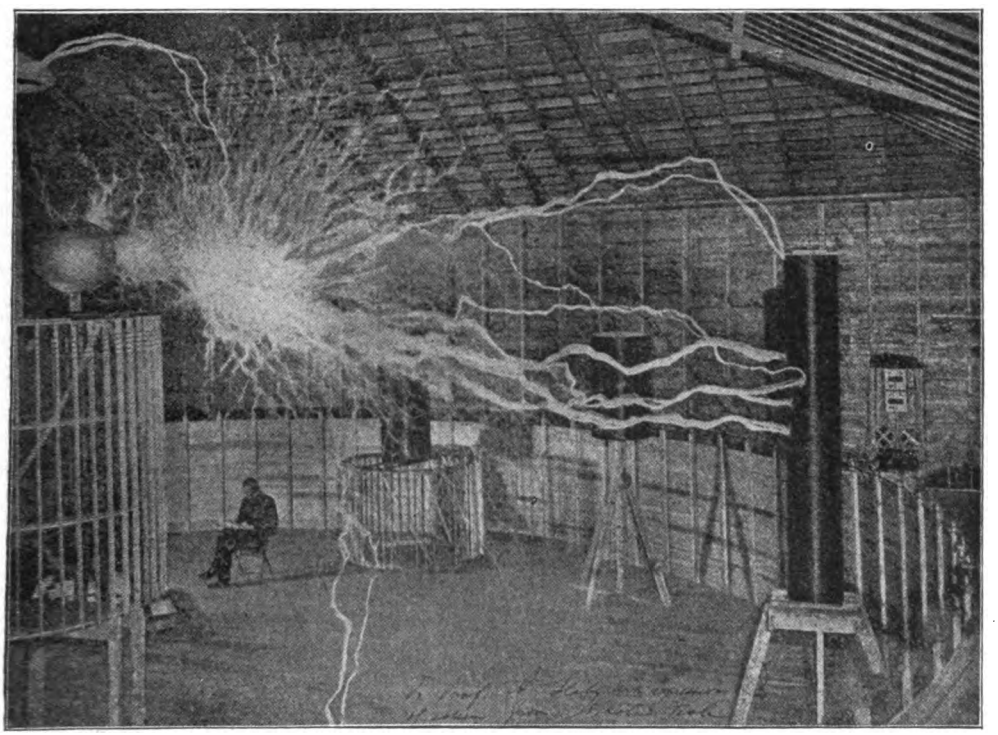

FIG. 4.

MORSE OFFERS $2,000,000.

Charles W. Morse, a director in the Garfield National Bank and the Bank of New Amsterdam, has made a proposition to the board of directors of the Telephone, Telegraph & Cable Company of America to purchase that corporation outright for $2,000,000 in cash. Confidential circulars announcing the offer made by Mr. Morse were mailed to the stockholders of the company, in which the board of directors recommended the acceptance of the offer, in view of the fact that "a large number of stockholders are not willing to advance additional funds." Mr. Morse represents himself only in the proposition.

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THE METAL NIOBIUM.

M. Henri Moissan has lately succeeded in preparing the metal niobium in a pure state by the aid of the electric furnace. An alloy of niobium and tantalum is first obtained by reducing the powdered mineral with carbon in the electric furnace. This alloy is crystalline, of a light gray color, and contains about two per cent of combined carbon. By a series of reactions the niobium is separated from the alloy in the form of niobic acid, which, after calcination, is a pure white powder. To prepare the niobium, the acid is mixed with powdered carbon and pressed into small cylinders; a number of these are placed in a carbon trough contained in a carbon tube, and the whole placed in the middle of the electric furnace. A few minutes' heating suffices, with a current of 600 amperes and 50 volts. The decomposition is violent, and as soon as the niobic acid becomes fused a lively effervescence takes place. After cooling, a well-formed ingot of metallic niobium is obtained, which contains from two to three per cent of combined carbon. The metal has been examined as to its physical and chemical properties. It is quite hard, and scratches glass and quartz easily. It is not fused in the oxyhydrogen flame, and therefore its fusing-point is above 1,800° Cent., but in the electric furnace it liquefies easily. As to its chemical properties, it is found to vary considerably from most of the other metals. It does not decompose water vapor at a red heat, and is almost unattacked by acids.

This makes this metal valuable material for electrical purposes and in taking the place of platinum. Hydrochloric and nitric acids and aqua regia have no action upon it; hydrofluoric and sulphuric acids attack it but slightly, but it dissolves rapidly in a mixture of hydrofluoric and nitric acids. The gases attack it more readily. The action of carbon is somewhat curious. When the metal is maintained in fusion in the presence of graphite it slowly absorbs carbon, which enters into combination. Niobium does not readily form alloys with the other metals. Sodium, potassium and magnesium may be distilled over it without combining, and it does not form an alloy with zinc. When heated with soft iron in fusion a small quantity enters into combination with the iron. The alloy shows an irregular structure containing fragments of niobium, a combination of the two metals, or perhaps a double carbide, and pure iron in excess. Oxide of chromium is reduced by the metal in the electric furnace, and gives a brittle alloy of chromium and niobium. Fused potash attacks the metal with the formation of an alkaline niobate. Chlorate of potash reacts upon it at a high temperature with brilliant incandescence, and nitrate of potash attacks it with violent disengagement of nitrous fumes. The reactions obtained with niobium seem to place it apart from the other metals and ally it to boron and silicon.

PENALTY FOR DIVULGING A TELEGRAPHIC OR TELEPHONIC MESSAGE.

A correspondent wishes us to inform him what the New York State law is covering the improper divulgence of a telegraphic or telephonic message. There is a special statute in this State, enacted at the last session of the legislature, which may be found to give an effective remedy. It is Chapter 661 of the Laws of 1901, amending Section 641 of the Penal Code. The object of the section, as thus amended, is to subject to a fine of not more than $1,000 or imprisonment for not more than two years, or both, "a person who (1) either wrongfully obtains or attempts to obtain, any knowledge of a telegraphic or telephonic message by connivance with a clerk, operator, messenger or other employe of a telegraph or telephone company; or (2) being such clerk, operator, messenger or other employe, wilfully divulges to any one but the persons for whom it was intended, the contents or the nature thereof of a telegraphic or telephonic message or dispatch intrusted to him for transmission or delivery, or of which contents he may in any manner become possessed.

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Telephone Magazine

THE ONLY INDEPENDENT TELEPHONE PAPER IN THE WORLD.

TEL. CENTRAL 2641. MARQUETTE BUILDING, CHICAGO.

SUBSCRIPTION:

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Published on the 1st day of each month.

ELECTRICAL ENGINEERING PUBLISHING CO.

JOHN C. McMYNN, PRESIDENT.

No corporation, firm or person either directly or indirectly interested in the production or sale of telephones or telephone materials of any sort has any connection, editorial or proprietary, with this publication.

The First Municipal Telephone System in England.

The first municipal telephone system installed in England was opened to the public last month at Tunbridge Wells, England, and from the Lord Mayor's speech at the opening of this telephone system we find that even among Queens and Kings the great telephone monopoly has dared to extend its cruel hands of oppression, and from the words of the Lord Mayor there is now nothing to fear from the National Company with all of its alluring temptations. We have done our best to expose the hollowness of its new tariff and in other quarters the exposure has been amplified, and the fashion Tunbridge Wells has set the whole kingdom will be readily copied. It would be good for the country if the funeral box for the National Telephone Company was well prepared before its lease expires in 1911. We can glean from this that the National Company has pursued the same methods the American Bell Company did here, that is, it charged rates far too high and gives a class of service far too low, and the people, sooner than be robbed by this monopoly, have banded together and have installed a municipal telephone system. The people of Tunbridge Wells may feel assured of the success of their movement, and while it is the first telephone exchange owned and controlled by others than the monopoly in England before, there will be hundreds like it. We congratulate Tunbridge Wells upon its stride forward.

President of Ice Trust About to Become President of an Independent Telephone Company.

Announcement is made that Charles W. Morse, ex-president and director of the Tammany Ice Company, had offered to buy the controlling stock of The Telephone, Telegraph & Cable Company of America, which, by means of acquiring franchises in the city of New York, had threatened to undermine the Bell Telephone Company. Mr. Morse's offer is to purchase the holdings of each stockholder of the company at fifty per cent of the amount

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he has paid in. The purchase is conditional upon at least two-thirds of the total number of shares. This almost insures an Independent telephone system in the city of New York, and connection with New York means that very little time will elapse before the entire country will be connected with Independent toll lines. The East has not been as rapid as the West in the building of Independent lines, but now that it is fairly started the development will be rapid.

A Question in Regard to the Division of Toll Earnings.

The question now uppermost in the minds of exchange owners is how will the toll business of the Independents be managed. It is the method of some exchanges that the toll belongs to the exchange where the call originated. This, of course, between towns of a like size is fair enough, but what proper division can be made between a city and a small town? It is not fair to put these two under the same division that we have just spoken of. In other exchanges there is a record kept and at the end of each month they divide the toll receipts. This seems to be the proper solution, as it is fair to both the city and the village.

A Wonderful Change in Independent Apparatus.

It is surprising how the method of constructing Independent telephone lines thruout the United States has changed. At the first start of the Independent movement the majority of the Independent telephone lines were constructed in a haphazard manner. Common-return iron wire circuits were used. They were strung on trees and short poles. Every wind and sleet storm brought trouble. The telephones they used were of poor quality and in no way compared with the Bell Company's lines, but today it is different. The instruments and apparatus in use today are far superior to that of the Bell Company. The Independent lines are copper metallic-circuit, strung on good, substantial poles, and with all the drawbacks that have been mentioned the Independent companies were successful. They are bound to be doubly so now, with the service that they are sure to give with properly constructed lines and instruments of such a high character as are now used by the leading Independent companies.

TELEPHONES AT ST. BERNARD.

A traveler in Switzerland began to ascend to the hospice of St. Bernard, but when about an hour's climb from the pass was stopped by a very dense fog, so waited for one of the dogs to come to his rescue. As the fog lifted somewhat and his canine rescuers did not appear, he persevered, and finally arrived at the hospice, where he was warmly welcomed by the good brothers.

Naturally his first inquiry was why the dogs were not sent out, according to custom, in so dangerous a fog, to which came the answer that he had not telephoned. "Telephoned!" he exclaimed in surprise, but recovered his equanimity on its being explained that shelters have been built all along the climb, and that each is provided with a telephone connected with the hospice. When called up the brothers send out a man and a dog, the latter of which carries bread, cheese and wine, and as they know from the telephone which shelter to go to, no time is lost and the wayfarer is at once relieved.

THE Sterling Electric Company, of Lafayette, Indiana, reports a flattering demand for its "flash-light" transfer system. Among recent patrons for this equipment are the Lafayette (Ind.) Telephone Company, 1,500 numbers, changed from the old system, together with the new style tubular drops.

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RECENT PUBLICATIONS.

"In the type-case of the printer, all the wisdom of the world is contained, which has been or ever can be discovered. It is only requisite to know how the letters are to be arranged. So, also, in the hundreds of books and pamphlets which are every year published about ether, the structure of atoms, the theory of perception, as well as on the nature of the asthenic fever and carcinoma, all the most refined shades of possible hypotheses are exhausted, and among these there must necessarily be many fragments of the correct theory. But who knows how to find them?

"I insist upon this in order to make clear to you that all this literature, of untried and unconfirmed hypotheses, has no value in the progress of science. On the contrary, the few sound ideas which they may contain are concealed by the rubbish of the rest; and one who wants to publish something really new — FACTS — sees himself open to the danger of countless claims of priority, unless he is prepared to waste time and power in reading beforehand a quantity of absolutely useless books, and to destroy his readers' patience by a multitude of useless quotations."—HELMHOLTZ.

ELECTRIC WIRING TABLES. By W. Perren Maycock. Containing Comparative Table of British and American Conductors. Variation of Candle Power with Pressure Underrunning and Overrunning the Lamps. Fuse Currents and Percentage Increase. Insulation Resistance and General Formula. The Maximum Demand Indicator and System of Charging. Ready Lamp Reckoner and Ready Wire Reckoner. And General Comparative Cost of Electricity and Gas, together with the report of the English Committee on Copper Conductors. A complete pocket edition containing all the rules and laws of Electric Wiring conforming to the English Standard. 146 pages. The MacMillan Company, publishers.

As a handy reference book this volume is of great value. Its small size and serviceable binding make it a valuable pocket reference book. As the rules and tables are set forth, it shows the author to be thoroly capable of a light work, and the printing and binding speak well for the publishers. The price of this volume is $1 and will be sent postpaid upon receipt of price.

THE A B C OF THE TELEPHONE. By James E. Homans, A.M. Theo Audel Publishing Company, New York.

This volume covers the telephone field in a general way. It does not treat completely upon any special part of telephony. Its chapter on transpositions is well written and is good. It contains a chapter on a brief survey of the theory of sound necessary to an understanding of the telephone. The chapter on the history of the telephone is well written; in fact, the entire book shows the author to be thoroly capable of writing upon the broad field of telephony. The following are the contents of this interesting work: The telephone apparatus and its operation; a brief survey of the theory of sound, necessary to an understanding of the telephone; a brief survey of the principles of electricity; electrical quantities; history of the speaking telephone; later modifications of the magnet telephone; the carbon microphone transmitter; the circuits of a telephone apparatus; the switch hook and its function in the telephone apparatus; the switchboard and the appliance of the central station; the operator's switch keys and telephone keys; improved switchboard attachments; switchboard lamp signals and circuits; the multiple switchboard; locally interconnected or multiple transfer switchboard; exchange battery systems; party lines and selective signals; private telephone lines and intercommunicating systems; full metallic circuits; large private systems and automatic exchanges; devices for protected telephone apparatus from electrical disturbance; the general conditions of telephone line construction; telephone pole lines; wire transpositions on a pole line; telephone cables and their use in underground and pole lines; circuit balancing devices; methods of measuring wire; useful definitions and hints of telephone management. Of course, one can not expect a complete treatise on all of these subjects in one volume. The book contains 268 illustrations and has 232 pages. Its index is arranged in alphabetical order; is useful, as the volume can be used as a reference book. The book is well printed, cleverly written and substantially bound in cloth; and undoubtedly will have a large sale. The price of this book is $1, and will be sent prepaid upon receipt of price.

CENTRAL STATION'S EXPERIENCES. From *Power*, The Power Publishing Company.

This volume is written in a conversational style and is a series of narratives on the trials and tribulations of a steam engineer while learning to run an electric station. The waterworks plant of the town of Millville had been augmented by an electric lighting plant, comprising a 50-light Brush arc dynamo and two 500-light incandescent machines, with the necessary circuits and appurtenances. The engineer, who was a bright fellow, and had studied as much as his limited opportunities would allow, was without practical experience in the operation of

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electrical machinery, and was correspondingly nervous over his new responsibilities. "You see," he confided to Jones, who had installed the plant, "I never actually run one of these blamed things, though I've been over to the Watertown station a good deal and watched 'em running." Jones promises the engineer that he would get back whenever he got in trouble and fix him up. The first couple of things the engineer runs up against is a defective arc lamp, excessive drop and three-wire circuits, careless parallel of dynamo, a dead dynamo and hot field coils, a break in arc circuit. The engineer is helped out of these troubles by the arrival of Jones. Jones shows him how to remedy his trouble in a clear and comprehensive manner; shows him how to put in a simple ground detective. These and a great many other troubles occur, but Jones always arrives and puts the engineer right. This book is well written and shows the author to be thoroly clever. A volume treating upon these different troubles written in the style this book is should have a large and ready sale. This book contains 106 pages and is filled with useful diagrams. It is bound in paper. The price of this volume is $1, and will be sent postpaid upon receipt of price.

A HAND BOOK FOR APPRENTICE MACHINISTS. Edited by Oscar J. Beale. Brown & Sharpe, Manufacturing Company, publishers, Providence, Rhode Island.

This book is intended for beginners in the use of machine tools. Of course the use of tools is something that only practice can make perfect, but there are a great many things that may be learned thru the medium of a book that will help in the practice. This little book contains 187 pages and 87 illustrations, and is bound in cloth. This book contains chapters on the care of machines, kinds of tools and work. Centering and the care of centers, turning, reading drawings, measuring, lacing belts, signs, formulas, drilling, counter-boring, tapping, cutting speed, the screws and its parts. The figuring of gear speeds, together with the figuring of pulley speeds, the changes of gears, the screw cutting, angles, setting of protractor, working to an angle, circular indexing, straight line indexing, subdividing of thread, together with later points. This little volume is one that should be of good value to those interested in machine work. Its chapter on lacing belts proves convincingly that the author has been there. All thru the book the author's practice and experience stands forth. The book is exceptionally well written and avoids all technicalities, as it should. The author may feel assured that his book is, as the title indicates, "A Hand Book for Apprentice Machinists." This book will be sent postpaid upon receipt of price.

THE TINSMITH'S PATTERN MANUAL, AND PATTERNS FOR TINSMITH'S WORK. By Joe K. Little, C. E. The *American*.

This book is intended for tinners, coppersmiths, plumbers, zinc workers, and to one in that line of business should be of great value. It contains the different problems that come up before a worker in that line of business and shows in a clever manner the successful workings of these problems. This is the second edition of this valuable volume, and undoubtedly would be of value to any one in making terminal heads and outside junction boxes. This volume will be sent postpaid upon receipt of $1.

HOW TO BECOME A GOOD MECHANIC. By John Phin. Published by the New York Industrial Publication Company, New York. Contains 65 pages; paper cover.

This is the second edition and bears the statement that it has been rewritten and greatly enlarged. The title is one that should appeal to many, for, how to become a mechanic is a hard and sore problem. It contains some points which should be of value to a young man on learning any trade. Then it tells what should be the education of a mechanic — what mechanics ought to know. This booklet does not go into detail and does not touch upon anything practical, but merely goes in to show what qualifications a youth should possess to become a good mechanic. The course of study for self-taught students, with practical hints and instructions, is well written and contains some valuable pointers.

ELECTRIC SPARKS. By Prof. James A. Bentans, A.M. Laird & Lee, publishers.

This little volume is the best pocket size, and is bound in leather with gilt edge, has 272 pages and contains a theory of electricity and magnetism, a chapter on batteries and accumulators and some well-written points on wiring and electric light, and also takes up both the construction and theory of dynamos and motors. It devotes quite a little space to electric railways, electric plating and galvanizing. It also covers telephone and

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telegraph cables, wireless telegraphy and electric welding. It also has a nice description of electricity applied to medicine and surgery. Of course all these different subjects can not be handled thoroly in so small a volume, but its descriptions are clear and cleverly written. This little volume is of value to everybody. Its tables of units are up to date and its vocabulary of electrical technical terms is complete. This book contains 116 illustrations, and reflects credit both upon the author and publisher. This volume will be sent postpaid on receipt of 75 cents.

INDUCTION COILS AND COIL MAKING. By H. S. Norrie. Spon & Chamberlain, publishers, New York city, New York. 270 pages and 79 illustrations. $1.

This is the second edition of this volume and bears the author's statement that it is thoroly revised and greatly enlarged. The book is given up to description of medical and bath coils, gas engine and spark coils. It also treats upon a great many coils of contact breakers, primary and secondary batteries, electric gas light. It devotes quite a bit of space on coils for X-ray work. Its chapter on up-to-date wireless telegraphy is well written and illustrated in a comprehensive manner. This volume covers a distinct field. As there has been a demand for some book on coils, there is no reason why this volume should not have a large sale, as it is well written and cleverly printed. It is bound in cloth and will be sent postpaid on receipt of price.

SIMULTANEOUS TELEPHONY AND TELEGRAPHY.

An article describing the system employed on some of the main German metallic circuit telephone trunk lines, by means of which these lines can carry simultaneously telephonic conversations and Hughes type-printing telegraph messages, appears in a foreign paper. It says that bridged across the two lines in addition to the usual telephonic apparatus is an induction coil, consisting of two similar coils wound in the same direction at the two ends of an iron wire core (not one over the other). These two coils are connected in series, and their junction point is connected to the telegraph apparatus, which works with an earth return; and the same point is connected thru a condenser to earth, the condenser thus shunting the whole of the telegraph apparatus. The connections of the lines at the two ends are, of course, precisely the same. It is seen that when traversed in series by the telephone currents the two windings on the induction coil tend to magnetize the core in the same way, and therefore the joint inductions of the coil is great, and it does not shunt off much of the speaking current. On the other hand, the telegraphic currents traverse the windings in parallel, and as by this arrangement they offer less inductions, they only suffice to damp the current variations just enough to prevent their acting on neighboring circuits without prejudicing the working of the Hughes apparatus. The condenser which assists this dampening action can, in some cases, be omitted or diminished in capacity, as, for instance, when the telephone line is on a pole by itself. Thus, on the bronze Berlin-Vienna line, the condenser at Berlin has been omitted, and at Vienna it has been reduced in capacity from two microfarads (which has normally been found the best value on such lines) to 0.25 microfarad. The condensers must also be carefully protected from lightning by sensitive lightning guards. Each of the windings of the coil has 15,700 turns, and a resistance of 1,150 ohms. This combined telephone and Hughes service has already been put in on the following lines: Berlin-Vienna, Berlin-Budapest, Posen-Breslau, Dresden-Chemnitz, Frankfort-on-the-Main-Strassburg (Alsace) and Hamburg-Lübeck.

PERSONAL.

Mr. Robert L. Graveley, of New Orleans, Louisiana, has accepted a position as manager of the Hattiesburg (independent) Telephone Exchange, Hattiesburg, Mississippi. Mr. Graveley has had considerable experience in the construction and management of telephone exchanges and was with the Peoples Telephone Company, of New Orleans, Louisiana, as assistant engineer during construction of said exchange, and is thoroly familiar with the independent situation.

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TALKS AND CROSS-TALKS.

BY THE INSPECTOR.

HINTS TO CORRESPONDENTS.

Write on one side of the paper only, and make sketch or diagram, when necessary. Endeavor to give all the facts bearing on the case, so as to enable the editor to answer intelligently.

Name and address must accompany each letter, not for publication, but for the information of the publisher.

132. DEAR SIR,—Will you kindly answer the following question: We have a number of old carbons here which we would like to know how to use again. Is there not some method of recharging them? They look just the same as new carbons, but smell strongly of ammonia. By answering this question you will greatly oblige a subscriber. J. C. P.

If there is gas in your city it would be a good plan to burn them out over a Bunsen burner. This may be done in the following manner: By holding the top part of the carbon in the hand over the top of the flame, turning it around until all parts have been touched by the flame, then allow them to cool, and repeat. If you are unable to secure gas, you may rid them of their ammonia by attaching a hose to a steam jet and turn the jet of steam upon them. Then after using either one of these methods, tighten up the binding posts on top of the carbon and dip them into hot paraffin, about an inch below the top. This will prevent the creeping of the salts, and your carbons will be as good as new.

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133. Will you kindly answer the following question and settle an argument: If the end of a paper-covered cable be left open, will it impair the cable in any way, and if it will, what is the best method to pursue after the factory end has been cut off? WILL.

The Inspector has known cases where lengths of cable as long as fifty feet have been ruined by being left open, so it is a practice to avoid. There are two methods which may be used, which are both good: One is to dip the end of the cable in shellac, or you may dip it in hot paraffin. Either one of these methods will prevent the deterioration of the cables.

---

134. DEAR SIR,—Will you kindly tell me what is the proper resistance of an induction coil for ordinary exchange?

C. WILLIAMS.

I would recommend an induction coil to have 3½ ohms and 22 B. & S. gauge, double cotton cover primary of sufficient length to allow for three layers, and the secondary to be 250 ohms single-covered silk, No. 36, B. & S. This coil will give good service for all-around use — that is, for either two dry or wet cells of battery and most of the transmitters in practice today.

---

135. We have a great deal of trouble here at our exchange from the fact that after a lightning storm all our telephones are grounded until we wipe off the dust between the carbon blocks on our lightning arresters. Kindly tell me if it is lightning that does this? Why is it? It does not blow the fuses. And what is the cause of this dust?

E. J. B.

The discharge of lightning does not get to your wires direct. It is merely the static effect which reaches your lightning arresters. This static current, being of high voltage and, practically speaking, no amperage, passes over the fuses, and, jumping across the gap between the carbon blocks to the ground, disintegrates the carbon, this disintegration of the carbon causing the ground. As long as the lightning does not do any more than this you may feel lucky.

---

136. GENTLEMEN,—What success has central energy met with in connection with toll lines where a central battery is used? Yours respectfully, C. M. D.

Where central battery is already in use there is no reason why central-energy signaling should not be installed. With properly constructed lines, and of not too great a length, it would be harder to cite a failure than a success, with both central battery and central signaling.

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137. DEAR SIR,—Kindly answer the following questions thru THE TELEPHONE MAG-

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AZINE: (1) Will a 15,000-ohm generator ring twelve 1,000-ohm bridging bells on a line three miles long with No. 12 iron wire? (2) Would you advise putting twelve such ringers on a line of that kind? Yours respectfully,
J. H. P.

You would have no trouble in ringing over this line. Of course, it would be best to use a 25,000-ohm generator and 1,600-ohm ringers; but your 1,000-ohm ringers, with a 15,000-ohm generator, with twelve on a line, would work in a satisfactory manner.

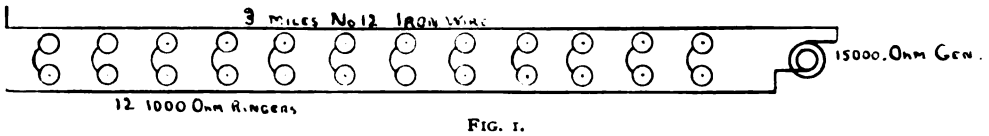

FIG. 1.

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138. DEAR SIR,—Would you kindly inform me of the best method of constructing a sweat-box with lumber and linings. Yours truly,
J. H. C.

I must confess I do not know what a sweat-box is. Will some of my readers kindly put me right?

---

141. DEAR SIR,—I see by your August number you answer question No. 131, and now you are in for more questions; but I know you are a good chap and will do all you can in the short time you must have to reply to all your readers.

Will you kindly tell me how and in what form to make a pair of magnets to magnetize the magnets for a gas engine sparking machine? When I ask how to make, I should say how big will my magnet spools have to be and what size wire will I have to use for a 500-volt line? If it is not asking too much, you can tell me what size to make my keeper and cores for the same.

You see you should not be in the question part of this magazine. In speaking of your magazine just let me say here that it is the best book I have ever had in the telephone line, and I buy all the books that come as long as my pay hangs out.

If you ever find a telephone man who wants my idea of your magazine, give the poor fellow a stamp and I will do all you can ask.

Hoping to hear from you in this matter and wishing you success, I am, yours, etc.,
E. M. T.

P. S.—If you can give me the name of some person who makes gas engine sparker castings in shape to wind I will thank you very much.

You will have to make a pair of coils ten inches long with 4-inch heads and 1-inch core. Wind each one with three hundred ohms of No. 22 wire. Of course it would not be an advantage for you to build a pair of these coils if you are only going to magnetize a few, but you could go to your local light plant and magnetize them off the field of the dynamo, or you could magnetize them off of any motor over one horsepower. In reply to your other question it is one of the rules of this department not to mention names of manufacturers.

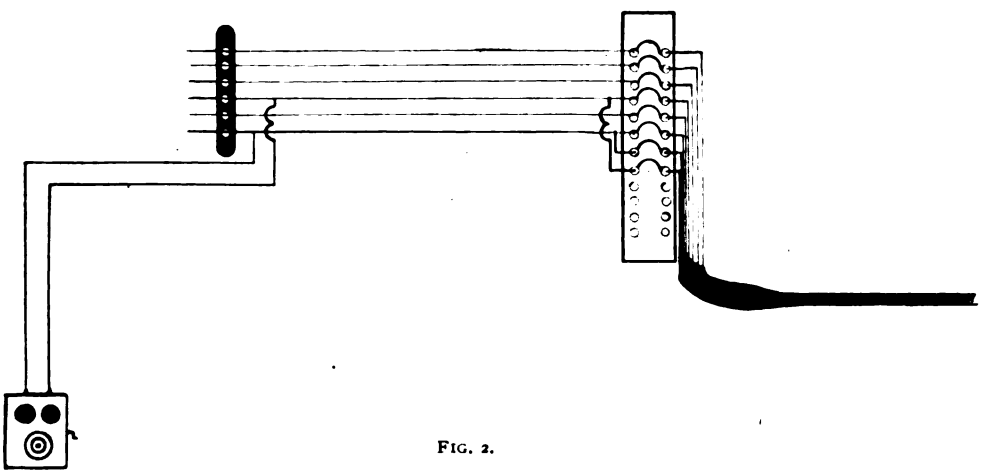

FIG. 2.

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142. DEAR SIR,— I shall be greatly obliged for a copy of your publication for examination. I am postmaster of this office, which is located on Lopez Island, one of the San Juan group, lying just east of the large island Vancouver, B. C.

On these islands we are looking to establish telephone systems. The greatest trouble will be to connect islands and these to the mainland, some ten miles off. Can you tell me what is the best method to pursue? Yours truly, C. CARROTHERS, Otis, Washington.

Of course, there will be only one way to do this, and that will be to connect with a submarine cable. The distance would not be great enough for the condenser or soaking effect to prevent good telephone service.

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144. DEAR SIR,—We would like to call the attention of practical telephone men of means to the great opportunity of constructing paying trunk lines thruout the State of Tennessee, connecting all the Independent systems. The Independents cover the greater portion of eastern and middle Tennessee, and what is needed is trunk lines connecting them with trade centers and one another. The feeders are here and would keep such trunk lines red hot. Would you kindly call the attention of capital seeking such investment to our State?

Your journal has reached our office regularly for the past two years, and we would not miss a copy of it. Success to you. Yours truly, MARTIN MARUGG, President.

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145. DEAR SIR.—We have a peculiar trouble with our exchange which we have been unable to locate. You will place us deeply in your debt if you will help us out of this fix. Our subscribers complain that when they talk in to central they hear a squeaking or hissing sound. We have looked over all our connections and they are all tight and we have added more battery to our operator's transmitter, and nothing seems to remedy it.

M. E. R.

The last line in your letter is the keynote to your trouble. You have too much battery for your operator's transmitter. The noise you speak of is what is known as sizzling, or frying, or the disintegration of the carbon in your transmitter. You will find that by working your transmitter with less battery, you will get away with this trouble.

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146. DEAR SIR.—Will you kindly tell us what is the best way to make up ground rods?

A. W. B.

One of the best methods is to take a length of half-inch gas pipe, cut it up into 4-foot lengths, and tin the end of the length. Solder a piece of No. 14 copper wire to the tinned end. It will then look like Fig. 1. You can have your trouble man make up a number of these while he is not doing anything else, and use them as you need them; all that is necessary to do is to drive them into the ground and connect one side of the 'phone to the piece of wire. You then have a ground connection that can be depended upon. Of course, galvanized iron pipe is preferable, but if you do not use this, you may coat your pipe with graphite. This may be done by getting the powdered graphite and rubbing it on the pipe.

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140. DEAR SIR,— Enclosed you will find a suggestion to telephone men engaged in maintaining and installing instruments in a small city and district in a radius of about one hundred miles. I am at present looking after and installing instruments in just such a district.

Frequently people living in the suburbs will require a 'phone on very short notice, and our lineman will be busily engaged repairing a break or another important work which he could not very well leave to string a long line; so, from necessity, I hit on a plan to get them connected to the exchange in a short time with little labor, that is if one of our leads run anywhere near their residence. Our system is all metallic, so I simply use one side of each of two subscribers' lines, as Fig. 2 will illustrate.

After the 'phone is connected in the whole leg, the lineman and I go to the office, take my testing set, disconnect the subscribers' lines on the distributing board or rack, the respective sides of which have been used for the new telephone, and fish for the new circuit. After receiving an answer from the new subscriber, I replace the wires and put a jumper on the sides of the lines used and connect to the number given him on the switchboard.

I find this system works admirably if a 1,000-ohm ringer is put on the instrument. Of course, as soon as the lineman finishes work that has got to be done, he strings a metallic line right thru for him.

Another place where this system comes in handy is where a subscriber living away out with, say, two miles of line, gives notice to have his 'phone taken out in a month or so, and another man in the same locality gives us an order about the same time for a 'phone which he wants immediately. We do not want to string a line for two miles where there will be a spare line in a month or so. I just connect the new man in with the new system till the other 'phone is taken out.

If you think this will be useful, please publish. Yours truly,

H. N. DIEGNAN, Subscriber.

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139. DEAR SIR,—Can you tell me the advantage of a series and a bridging drop in a small switchboard of twenty-five lines? Which is the best for a small exchange having mostly bridge instruments? Yours truly,
J. H.

By referring to Fig. 3 this is the connection of a drop in series, with a tele-

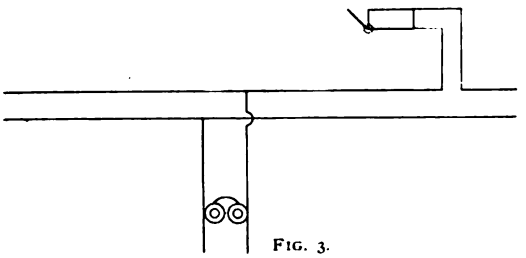

FIG. 3.

phone connected on the line in multiple or bridge. You may see from this what the effect would be. All the current to ring the bells on the line would have to pass the lines on this drop, and as the drop would be high in inductive resistance you would be unable to ring the bells on the line. Now, referring to Fig. 4, there is a drop on the same line bridged in; you will see by the connec-

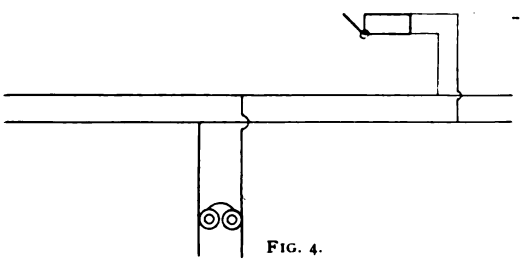

FIG. 4.

tion that it divides its current with the bells, so would say by all means use a bridging switchboard. By using all bridged you will still be able to use your series 'phones, whereas if your switchboard was in series you would not be able to use your bridging 'phones.

NAIL TERMS.

Many persons are puzzled to understand what the terms "fourpenny," "sixpenny" and "tenpenny" mean as applied to nails. "Fourpenny" means four pounds to the thousand nails, or "sixpenny" means six pounds to the thousand, and so on. It is an old English term, and meant at first "ten pound" nails (the "thousand" being understood), but the old English clipped it to "ten-pun," and from that it degenerated until "penny" was substituted for "pounds." When a thousand nails weigh less than one pound they are called tacks, brads, etc., and are reckoned by ounces.

MUNICIPAL TELEPHONES AT TUNBRIDGE WELLS.

According to *The Times* the Lord Mayor of London, accompanied by the Lady Mayoress, visited Tunbridge Wells on Saturday and inaugurated the system of municipal telephones established there. The event was characterized by much local demonstration, and the town was brilliantly decorated. Tunbridge Wells is the first town in England to complete a municipal system in competition with the National Telephone Company. The company, after unsuccessfully attempting to purchase the license, has resorted to cutting rates and is at present offering a practically unlimited service for $20—exactly half its former charge. The corporation's system has cost about $50,000, and the service covers an area of 240 square miles, nearly all the villages in a ten-mile radius being connected with Tunbridge Wells. At the present time there are over five hundred subscribers. The corporation's charge is $28 for unlimited service, and there are two toll rates for small users, namely, $17 and 1 cent per call, and $10 and 2 cents per call.

MUNICIPAL TELEPHONY.

Dundee telephone committee are considering the advisability of applying for a license to establish a municipal telephone exchange. A Manchester firm of telephone engineers offers to introduce a syndicate which would undertake to establish the service on a $25 rate.

Before making a recommendation on the proposal to establish a municipal telephone exchange, the Aberdeen telephone committee have decided to grant an interview to Mr. W. E. L. Gaine, the general manager of the National Telephone Company.

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KELLOGG SWITCHBOARD & SUPPLY COMPANY.

The Kellogg Switchboard & Supply Company, Chicago, Illinois, has recently placed on the market a new type transmitter, which, in actual service on local and long-distance lines, is giving perfect satisfaction. It is designed not only to give the most powerful transmission, but perfect articulation, thus making it fitted for all conditions of service. The electrical and mechanical design has been so carefully worked out that the company gives it a five-year guarantee. It has placed on the market a new re-receiver which is smaller in size and much lighter in weight than its former receiver. The electrical and mechanical design has been greatly improved. It is claimed to be a very sensitive receiver and will not only respond perfectly to the most powerful electrical transmission, same as obtained on short central-energy lines, but will also respond clearly to the weakest transmission of long-distance lines. The retaining case which conceals all metal parts, including the binding posts, is made strong in places subject to the most severe strains.

INTERNATIONAL TELEPHONE PUBLISHERS.

The International Telephone Publishers, Grand Rapids, Michigan, announce that it is their intention to publish diagrams of circuits of telephone systems, both central energy and magneto, also house systems, magneto combinations, party-line system and the standard wiring of telephones of the leading manufacturers. Some of the above have already been published. See advertisement in current issue. Every issue will be of value and should be in the hands of every telephone man.

NORTHWESTERN COMPANY WINS IN ITS LAWSUIT WITH THE CHICAGO TELEPHONE COMPANY.

Judge George Brown, in the Kane county Circuit Court at Geneva, gave a decision in the case of the Chicago Telephone Company versus the Northwestern Telephone Company, ruling against the contention of the Chicago company, which sought by an injunction to preserve a monopoly of the use of all streets already occupied by the Chicago Telephone Company. The principal issue in the case was as to whether or not the Chicago Telephone Company, by reason of prior occupancy of the streets of Aurora, had exclusive rights in the streets which could not be interfered with by any other company.

The Chicago company maintained that by reason of such prior occupation it had certain exclusive rights in the streets which could not be interfered with by any one. The Northwestern Company, on the other hand, maintained that the streets of the city of Aurora were intended for the benefit of all companies and that it had the right to overbuild or underbuild any other system of wires so long as they did not unnecessarily interfere with the practical operation of the other company's plant.

Nearly 1,500 pages of testimony was taken in the case by experts all over the United States as to the custom of overbuilding and underbuilding in other cities. They found that such custom of overbuilding one system of wires by another had proved reasonably safe.

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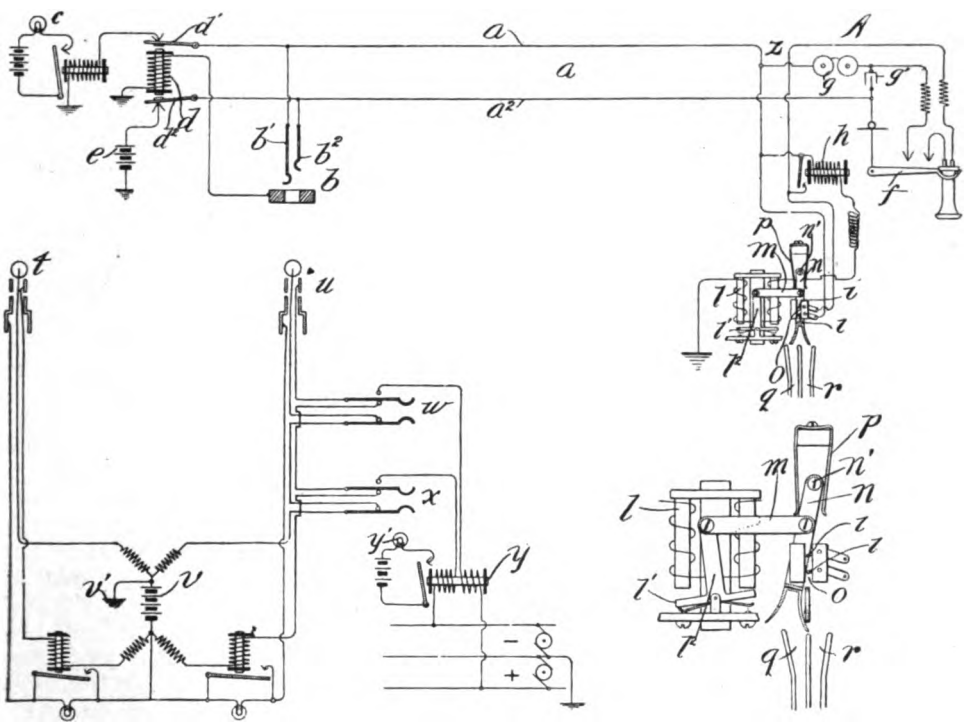
MONTHLY DIGEST OF TELEPHONE AND KINDRED PATENTS

EDITED BY CLARENCE C. BROWN.

Copies may be had, postage paid, by enclosing 5 cents for each one. Address inquiries in care of this magazine or Washington, D. C.

ALBERT M. BULLARD, CHICAGO, ILLINOIS. APPARATUS FOR TELEPHONE LINES, ASSIGNED TO THE WESTERN ELECTRIC COMPANY. No. 679,068. July 23, 1901.

This is a toll device. In the invention the circuit of the telephone lines were normally closed at the central office thru a line indicator, is normally open at the subscriber's station, two terminals being there provided for controlling continuity or the talking and signaling circuit between which terminal circuits may be completed in either of two ways by the deposit of a coin in the coin-receiving toll box, or by means of a relay thru which current may be directed from the central office. In the coin box there is a magnet by which the coin may be either returned to the subscriber, or may be dropped into the coin-receptacle proper—that is to say, if the connection desired by the subscriber can be obtained, the coin which he has previously deposited in order to complete the signaling circuit thru his line indicator, the coin is then directed into the cash box, or if the desired connection is not secured the coin may be directed into a coin chute leading to the outside of the box.



No. 679,068.

Now, referring to the drawing, the subscriber's station A is connected with the central office by means of the telephone line *a*, having two branches a^1 and a^2, which terminate in the line-springs b^1 and b^2, respectively, of spring jack *b*. The branch a^1 of the telephone line is normally connected

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thru a line indicator *c* to ground by the way of the back contact d^1 of the cut-off relay *d*. The branch a^2 of the telephone line is likewise connected to ground thru a battery or source of current *e* by way of the back contact d^2 of the cut-off relay.

At the subscriber's station the usual telephone apparatus for talking is located, the talking circuit being controlled in part by the switch hook *f* in the usual manner. A high resistance polarized signal bell *g* is permanently bridged across the telephone line from a condenser g^1. The telephone system illustrated is that known as the "common-battery system"—that is, a system wherein the subscriber's transmitter is supplied with current from a centralized battery at the exchange office. This is well known and needs no further description.

There is a break *z* in the branch a^1 of the telephone line at the subscriber's station, as indicated, and this break, if not closed, will prevent conversation being had over the line. It may, however, be closed in two ways, which I will describe—that is to say, first, thru the front contact of the relay *h*, and, second, between the terminals *ii* by the deposit of a coin.

The helix of the relay magnet *h*, whose armature controls thru its front contact 4 bridge across the break *z* in the telephone line, is permanently connected to ground from the side a^1 of the telephone line thru a retardation coil and the helices of the polarized coin-distributing electromagnet *l*.

The tilting armature l^1 of the polarized magnet *l* is connected by means of the arm 12 and link *m* with a swinging stop *n*, pivoted at *n'* and normally maintained in a position to arrest the passage of a coin thru the coin chute *o*, wherein the coin-contacts *ii*, forming the terminals of the telephone line a^1, are located by a centralizing spring *p*. The swinging valve *n* is adapted to be moved to one side or the other by the armature l^1 of the polarized electromagnet under the influence of positive or negative direct current which may be sent thru the coils of said magnet, and so to release the coils and allow it to fall, guiding it either into cash-box chute *q* or into the return chute *r*, according to the direction in which the armature tilts.

At the central office a pair of connecting plugs *t u* are provided between whose tip and ring strands the centralized battery *v* is bridged thru the usual repeating coil. The battery *v* is grounded at v^1. Two keys *w* and *x* are included in the tip and ring strands of the plug *u*, which keys are adapted when depressed to open the tip strand and connect the ring strand with a grounded source of negative direct current, respectively, thru portions of the helix of the relay *y*, which controls a signal-lamp y^1.

PERCIVAL G. BURGESS, OF MEXICO, MEXICO, AND HENRY W. WILDER, OF ALBANY, NEW YORK. TELEPHONE CIRCUITS, ASSIGNED TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS. No. 11,922. July 23, 1901.

In telephone exchange practice conditions frequently occur under which it becomes desirable that while two persons engage in conversation by telephone, one shall be able to listen to and receive messages from a third telephone, which messages or like transmitted conversation, however, shall remain unheard by the other. Such a case is found when a central telephone exchange operator is required to attend to calls and make and supervise switch connections between substation lines and also to receive communications over an "order wire," or "instruction circuit," from other operators. Sometimes also it is desirable that the operator shall be provided with means to so transpose the connections of her telephones that conversation can be by them transmitted as well as received only over the service lines. At other times it may be desirable for the three kinds of circuit — to-wit, the circuit of the operator's telephone, the order circuit and the service circuit of any kind — to be so interconnected that each one may talk with and hear either or both of the others and again for the three circuits to be so relatively arranged that a given one may hear and talk to the other two,

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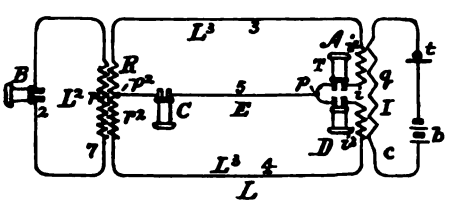
which, however, can not hear or talk with each other.

Attempts have heretofore been made to carry out the foregoing ideas more or less perfectly, the most practical prior expedient being the employment of such an operator's receiving telephone as that described in letters patent of the United States, No. 487,219, granted to Hammond V. Hayes and Wilton L. Richards, November 29, 1892, the same having two inducing magnets, each with its own coil and diaphragm, the poles and helices of each magnet being arranged in a position inductively neutral to that of the other; but such a compound telephone is so heavy and cumbrous that it can not be worn by an operator (except for a short time) without inconvenience, and its efficiency is not very high. By means of this invention the ordinary standard single-circuit telephone can be used by the operator, and it reproduces the speech transmitted over the two independent circuits concerned — for example, a "service circuit" and an "order circuit"— substantially as well as it could were it associated with either circuit alone.



No. 11,922.

The invention comprehends a compound circuit arrangement wherein three telephones are so relatively placed and connected by appropriate circuit conductors that while the receiving instrument of one of them, which we may call A, shall be responsive to the transmission of both the others, B and C, and shall be able to reproduce the messages transmitted by means of the others, the receiver of B will not respond to, receive, or reproduce the transmission of C, and the receiver of C will in like manner be neutral or irresponsive to B. This general arrangement can be carried into effect by connecting two of the telephones, either thru the intermediation of repeating induction coils or directly in one circuit, so that each can transmit to and receive from the other, and by forming a new circuit containing the third telephone or telephone apparatus and one of the others in part from certain portions of the conductors of the first circuit and in part of an auxiliary conductor which extends and joins to opposite, but equipotential, points in the first circuit. One way of constructing such an arrangement, which has been put into use and found practically efficient, is to have the first-mentioned circuit in two sections conductively separated, but inductively united by a repeating induction coil of ordinary construction, the two windings of the said coil and two of the telephones A and B being connected in the two circuit sections, respectively. In one of the circuit sections the mode of connecting its telephone B is immaterial and it is placed in series with the repeating coil helix; but in the other circuit section the secondary winding of the transmitter induction coil is split or severed centrally into two equal portions, and the telephone receiver A, in series with an impedance coil or device of equal electromagnetic value (an exactly similar telephone receiver may, in fact, be employed) is connected between the two portions of the said split winding. A point between the said receiver and the impedance and another point at the middle of the repeating-coil winding are then equipotential points of the same circuit section, and the auxiliary conductor, including the third telephone C, is extended between and unites them. When this construction is adopted, it can talk to A but not to C, C can talk to A but not to B, and A can listen both to B and C, but can only talk to B. The invention also comprehends the association with a system of circuits of a circuit-changing switch which, in one position, maintains the relations already described and which, when placed in a second position, reverses or transposes the said relation in such wise that B assumes in respect to A the former relation of C, and C the former relation of B, so that A can, as

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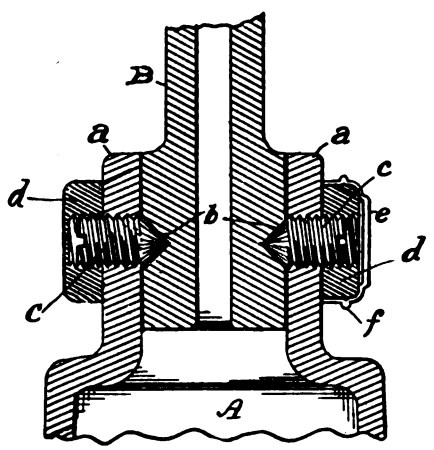
before, hear both, but can now talk to C instead of to B. Thus the transmission of A is alternative to B and C. The circuit changer, however, can be and preferably is so devised and constructed as to be capable of assuming a third position, in which A can talk with and hear both B and C, and B and C can talk with and hear each other. Moreover a number of modifications can be made in the compound-circuit organization without departing from the principles of this invention. For instance, the results which, as hereinbefore detailed, can be realized by means of the circuit-changing switch, may also be attained (albeit not alternatively or selectively) by a slightly changed permanent arrangement of the circuit conductors.

The illustration is a diagram of a compound circuit exemplifying the principles of this invention.

HERBERT B. SABIN, OF CLEVELAND, OHIO. TELEPHONE TRANSMITTER ARM JOINT. No. 680,077. August 6, 1901.

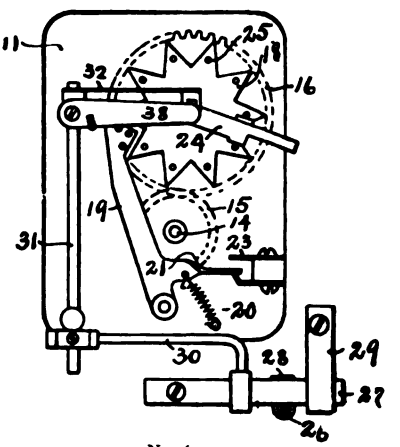
In this patent the arm is seated between the lugs of the base and has on each side conical depressions and headless threaded screws, which have conical points and fit in the conical depressions. Being arranged in this manner, when the screws are tightened the arm is held in a rigid position. This invention is fully set forth in the illustration.



No. 680,077.

FRANK A. LUNDQUIST, CHICAGO, ILLINOIS. CALLING DEVICE FOR TELEPHONE EXCHANGES, ASSIGNED TO THE NATIONAL AUTOMATIC TELEPHONE COMPANY, CHICAGO. No. 679,029. July 23, 1901.

This is a calling device for automatic telephone exchanges. This invention consists of the usual dial and pointer together with a crank connected to the pointer, which is in turn connected to a closing-circuit device, operated by separate means so that the rotation of the crank will send a series of impulses over the circuit, and that a second closing-contact device relieves the pointer from the crank so that the pointer may return to its normal condition.



No. 679,029.

GUSTAVE SELIGMANN-LUI, OF PARIS, FRANCE. COUNTING TELEPHONIC MESSAGES. No. 679,998. August 6, 1901.

In reference to the drawing, *o* represents the line connecting the calling subscriber with the central station. The magnet and shutter mechanism indicated at 1, and the coil of the magnet A, is in circuit with a source of electricity 2, utilized in the ringing up of the instrument. 3 is the key which is used as occasion requires to either connect the line *o* with the source of electricity 2 or with other instruments. 4 is the key used to close the circuit of the source of electricity 5, which is disposed to act upon the apparatus of the central office. The battery 5 may be located at the subscriber's end, as illustrated in

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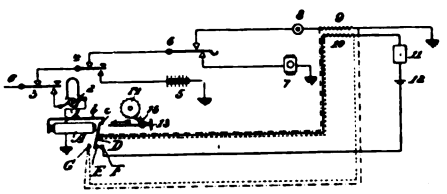
the drawing, or located at the central office as the central battery. 6 is the usual switch, adapted to bring into circuit either the subscriber's bell 7 or the subscriber's telephone apparatus, which consists, ordinarily, of the receiver 8 and the secondary 9 of the induction coil. 10 is the primary of the induction coil, 11 is the microphone, and 12 is the microphone battery. 13 represents the push-rod and button of the counting apparatus, which consists primarily of a ratchet wheel 14 and a pawl 15, mounted upon the rod 13, which

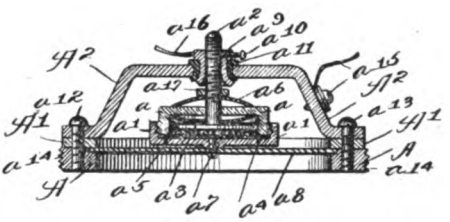


No. 679,998.

pawl, as the rod 13 is pushed in, is adapted to advance the ratchet 14 one unit. The rod 13 has its inner end resting adjacent to the shutter D, and when forced inward, as indicated by the arrow, the rod 13 not only operates thru the pawl 15 the ratchet 14, but it also forces the shutter D to its elevated or locked position in engagement with the hook *c*. The mechanism 1 is not placed in action, but remains at rest so long as the subscriber is only sending thru the key 4 and the source of electricity 5, which controls the current intended to cause the operation of the apparatus of the central office. When, however, the necessary operations of the central office are completed, the subscriber rings up the subscriber by means of the source of electricity 2, which alone is capable of acting upon the ringing apparatus of the correspondent's instrument. The electromagnet A is then energized and attracts the armature B, which thru the rod *b* and hook c releases the shutter D. The shutter D in falling breaks the primary circuit of the microphone between the spring F and the piece E. In this position of the parts the subscriber may continue to call the correspondent and may even hear who comes to the correspondent's instrument; but he can not converse with the correspondent until the shutter D is replaced in engagement with the hook *c*. The sole means of replacing the shutter D is the push-rod 13, which, in the act of replacing the shutter D will, thru the pawl 15, actuate the ratchet counter-disk 14 to cause said disk to advance one unit. Instead of breaking the primary circuit between the piece E and the spring F the contact of the piece E with the contact G may be utilized to short-circuit the primary or secondary wire of the induction coil.

JAMES G. NOLAN, CHICAGO, ILLINOIS. TELEPHONE TRANSMITTER. No. 678,972. July 23, 1901.

In this transmitter the receptacle for holding the carbon granule is made of glass. Referring to the drawing, screws a^{12} and a^{13} are adapted to be placed thru perforations in yoke piece A^2; *a* is the glass cup which holds the resisting matter or carbon granules.



No. 678,972.

This glass cup is held in tension by the spring A^6, a^5 is like spring adapted to be placed on the inside of the cup or case *a*, and to exert a pressure against the plunger electrode a^3, having a tendency to force the spring in so that the case *a* and the diaphragm a^8 will, by the opposing tension of both springs, be held in a state of delicate equilibrium; this may be adjusted by varying the relative strength of either of the springs.

WILLIAM M. DAVIS, CHICAGO, ILLINOIS, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, CHICAGO. TELEPHONE EXCHANGE SYSTEM. No. 679,731. August 6, 1901.

In this invention line conductors are employed for the relay circuits, the plug serving to include these conductors in circuit with the line relays. Upon their

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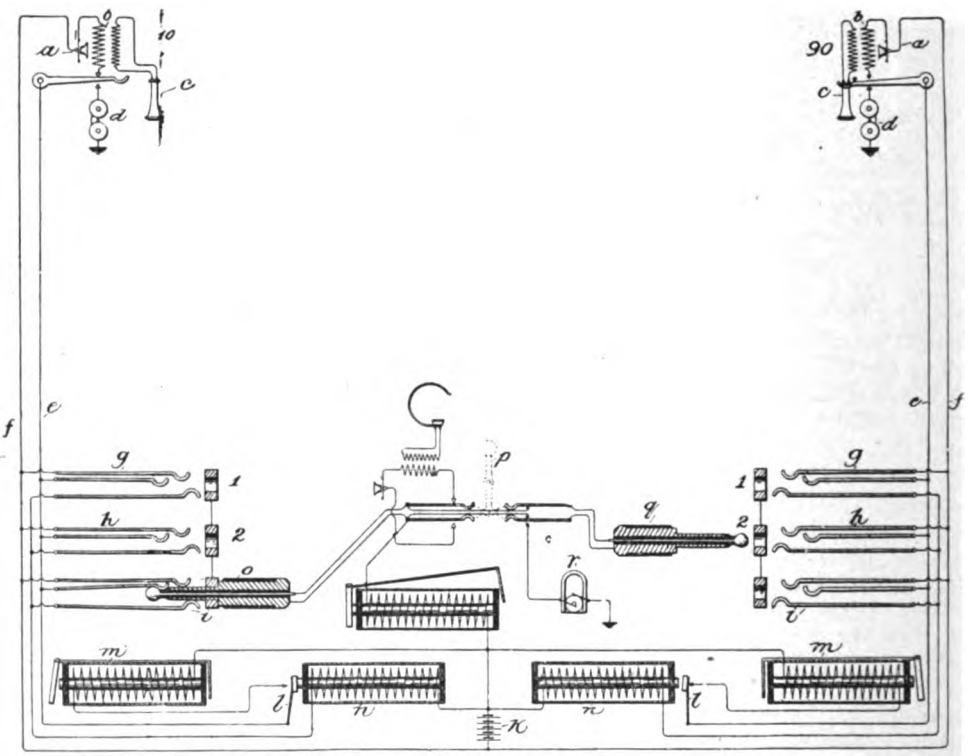
insertion within spring jacks the same battery which is employed for actuating the line-indicators being also employed in the operation of the relays. By reference to the drawing, which illustrates a metallic circuit multiple switchboard system equipped in accordance with this invention.

A battery transmitter *a*, with its coil *b* and receiver *c*, is illustrated at each of these stations, a secondary coil at each station in this particular instance being at said station being upon its hook. This, however, is not limited to the precise arrangement of the telephone apparatus at the subscribers' stations that is shown. There is also provided at each station a call bell *d*, preferably responsive to alternating current, which is included in a ground branch that is closed when the telephone receiver at that station is upon the hook. The metallic-circuit telephone lines extend from the sub-stations to an exchange. The



No. 679,731.

included in a local or short circuit with the telephone receiver thereat, while the primary coil in circuit with the transmitter is placed in circuit with both limbs of the corresponding telephone line upon the removal of the receiver from its spring switch hook. The transmitter primary winding of the induction coil at station 10 is thus shown in series with the telephone line, the telephone receiver at this station being removed from its hook. The transmitter circuit at station 90 is open, the receiver limbs *e* and *f* of each metallic line extend to spring jacks *g* and *h* upon sections 1 and 2 of the multiple switchboard and are also connected with an answering jack *i* at section 2. A common battery *k* is preferably connected in bridge between the sides of the telephone lines. The limb *e* of each line terminates in a spring lever *l*, normally resting against a contact *aa* constituting a terminal of a line-indicator *m*, the other terminal of the line-indicator being connected with one terminal of the

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common battery, the remaining terminal of the common battery being preferably permanently connected with the limb *f* of each line. A subscriber, in initiating a call, closes the circuit of the battery *k* thru the line-indicator and the spring-lever *l*, normally in circuit therewith. A relay *n* is associated with each line-indicator. One terminal of this relay is connected with one terminal of the battery *k*. The remaining terminal of each relay is in this particular instance connected with the longest line-spring of each jack for the purpose hereinafter to be set forth. Each line-jack employs three contact-springs, the shortest being adapted for engagement with the tips of the inserted plugs, while the two remaining springs are both adapted for electrical contact with the same sleeve. The short line-spring of each jack is connected with one side of each telephone line, the spring of intermediate length is connected with the other side of the telephone line, while the longest line-springs of the jacks associated with each line are directly together and are normally disconnected from said line. A plug is thus adapted by uniting the two longer line-springs of a jack to connect one terminal of a relay *n* with one side of a telephone line, and as the other terminal of each relay is permanently connected with the other side of the telephone line the relay is at once energized upon the insertion of a plug, being preferably included in a local circuit at the exchange.

Assuming that subscriber No. 10 wishes telephonic communication with subscriber No. 20, the calling subscriber, by removing his telephone from its hook, operates his line-indicator. The operator, in response to this signal, inserts the answering plug *o* within the answering jack of the calling subscriber, and by a proper manipulation of her key *p* includes her telephone in circuit with the calling subscriber. Ascertaining that this subscriber desires communication with subscriber No. 90, she inserts the connecting plug *q* with the line-jack of the called subscriber and by means of the key *p* includes the generator *r* in circuit with the grounded signal bell *d* at the called subscriber's station; it preferably includes a clearing-out indicator in circuit with the battery between a side of the telephone circuit and a cord strand, as indicated. Immediately upon the insertion of the plugs within the jacks, as has been explained, line-relays *n* are energized and the spring-levers *l*, carrying armatures for these relays, are attracted toward the relays, whereby they are disconnected from normal contacts constituting terminals of the line indicators, the indicators thus being cut out of circuit. Thus, simply by the addition of an extra contact-spring in connection with each jack, to dispense with the special local circuit heretofore commonly employed in the control of the line relays.

CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY. Specification covering part of reissued letters patent No. 11,929, dated August 20, 1901.

This supervisory signal invention contemplates the use of electromagnetic supervisory signals controlled by relays, each signal having two windings differentially disposed, one of which is in a local circuit closed in making connection with a line and the other of which is in a branch of the local circuit, controlled by the supervisory relay to be closed when the relay is excited. Thus the magnet of the supervisory relay may be rendered inert through the action of the controlling relay without altering the electromotive force applied to the conductor associated with the line.

The invention is illustrated in the diagram on page 224. This drawing shows diagrammatically two telephone stations with lines extending to switching and signaling apparatus in a telephone switchboard, and a pair of plugs and their plug circuit for uniting the lines in the switchboard.

The line circuit at the sub-station — as station A, for example — is complete as respects alternating current thru the polarized signal bell *a* and condenser *a'*, but when the telephone switch a^2 is relieved from the weight of the telephone, the switch completes a circuit of low resistance between the conductors of the line thru the telephones a^3 and a^4. This

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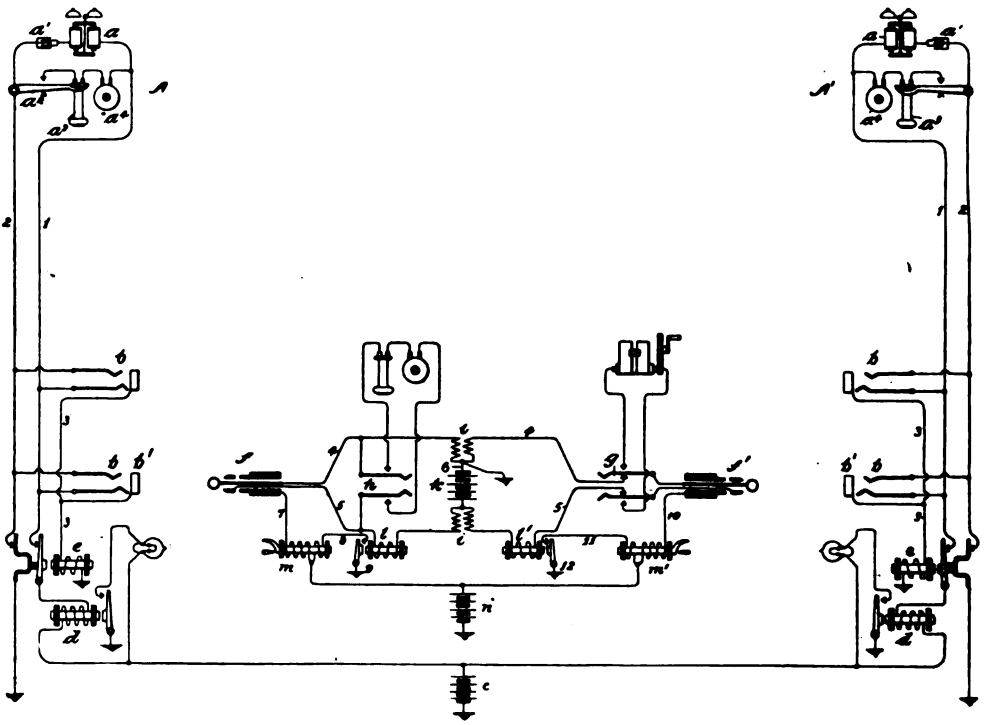
apparatus constitutes the ordinary equipment of a sub-station adapted for the automatic operation of signals in a switchboard.

The line conductors 1 and 2 from the sub-station are led to the line terminal contacts of spring jacks *b* in the switchboard. Thence the conductor 1 is extended to one pole of a battery *c* common to the different lines of the exchange, the magnet of a line signal *d* being interposed in the conductor, while the line conductor 2 is led directly to earth. The continuity of these conductors is controlled by the switch contacts of a cut-off relay *e*. The spring jacks are provided with the local contacts *b'*, which serve as test rings for the spring jacks. These contacts form multiple terminals of a grounded conductor 3, which includes the magnet winding of cut-off relay *e*.

The link conductor before mentioned comprises connecting plugs *f* and *f'*, uniting the tips of the plug circuit 4-5, conductor 5, the ring contacts, which are designed to make connection with the longer line-springs of the spring jacks.

The usual calling key *g* is connected with the plug circuit for applying a source of calling current to the plug *f'*, and likewise a listening key *h* for connecting the operator's telephone in a bridge of the plug circuit. The windings of repeating coil *l* are interposed in the plug circuit, two of the four windings of the coil being serially connected in each conductor of the plug circuit. A bridge 6 of the plug circuit is formed by uniting points on conductors 4 and 5 intermediate of the serially connected windings in those conductors. A source of current K is included in this bridge for supplying current in the lines for operating the signals and exciting the sub-station transmitters while lines are united through the agency of the plugs.

A relay controlling a supervisory signal is interposed in the portion of conductor 5 of the plug circuit in either hand of the bridge 6. The relay 1 in circuit toward the plug *f* is designed to



No. 11,929.

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control a supervisory signal referring to that plug, while relay l^1 in circuit toward plug f' is to control a signal r referring to the latter plug. The signals thus controlled are electromagnetic indicators m and m^1, respectively, which are constructed to display their indicators only when their magnets are excited.

The sleeve contacts of the plugs, which register with the test rings b^1 of spring jacks, into which they are inserted, form the terminals of conductors of the local circuit referred to in the general description. Thus the sleeve contact of plug f is connected with a wire 7 leading to the free pole of a grounded battery n. This wire 7 includes one of two magnet windings of the controlling magnet of signal m. A branch 8 from the same pole of the battery is led thru the other winding of the same magnet to one contact point of the relay 1, whose other contact point is grounded by wire 9. Similarly wire 10, which includes one winding of signal m^1, leads from the free pole of the same battery to the sleeve contact of plug f, while a branch 11-12, including the other winding of the same signal-controlling magnet m^1, is controlled by the switch contacts of relay 1. The wires 7 and 10, associated with the answering and calling plugs, respectively, are designed to come into circuit with the wires 3, including the magnets e of the cut-off relays of the telephone lines with which such plugs may be connected. Hence, inasmuch as the two windings of each of the signals m and m^1 are intended to neutralize each other when both windings are excited, the windings in wires 7 and 10, respectively, should have more turns than the windings in wires 8 and 11, such that the number of ampere-turns of the two windings of each signal will be equal.

The removal of a receiving telephone from its switch at a sub-station permits current to flow from the common battery c, which excites the line signal d and indicates a call to the attendant. The operator then inserts an answering plug f into the spring jack of the calling line, at the same time bringing her telephone into connection with the plug circuit, which then forms an extension of the calling line to learn the order. The insertion of the plug closes the local circuit 7-3, whereby the cut-off relay e of the calling line is excited and caused to sever the normal ground connections of the line, while at the same time current is provided in one winding of the supervisory signal m. It will be noted, however, that current flowing from battery k thru the plug circuit 4-5 and the line circuit will simultaneously excite the relay 1 and cause it to close the local circuit 8-9, whereby the supervisory signal m will be rendered inert, the effect of its windings on the core being differential and equal. The current flowing in the circuit 7-3 produces a difference of electrical potential between the test rings b^1 and the spring jacks of the line with which connection has thus been made and the earth, which serves to indicate the busy condition of the line to an operator subsequently making a test. In making connection with another line in compliance with the subscriber's order, the operator inserts plug f into a spring jack of the line called for. Thereby the cut-off relay e of that line is excited and severs the ground connections of the line. The circuit 10-3 being closed, current is created in a winding of the supervisory signal m^1, and the test rings b^1 of the line are electrified to a difference of potential depending on the electromotive force of battery n and the resistance in conductors 10 and 3, respectively, in accordance with well-known electrical laws. The operator calls by means of key g in the usual way. In this case, however, the relay 1 remains inert until the called party responds to the call by removing his receiving telephone from its switch. Until that time, then, the circuit 11-12 remains unbroken and the supervisory signal m^1 displays its indicator to the operator. The display of this indicator denotes to the operator that the called party has failed to respond, and permits her to transmit a second call signal, if such be needed. The response of the called party, however, by permitting the excitement of relay 1-1, renders the controlling magnet of the supervisory signal inert and effaces its indication. It

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will be observed that the operation of the relay 1-1 in no wise affects the difference of potential between the test rings b^1 and the earth, so that the busy test of these spring jacks is of a constant nature. This feature of the invention constitutes an important improvement in the operation of supervisory signals. The breaking of the circuit at either sub-station by the replacement of the telephone on its switch there is indicated by the supervisory signal m or m^1, referring to the plug connected with that line. The replacement of both telephones effects the display of both supervisory signals, which may be accepted by the operator as a call for disconnection and may be followed by the removal of the plugs from the spring jacks of the connected lines.

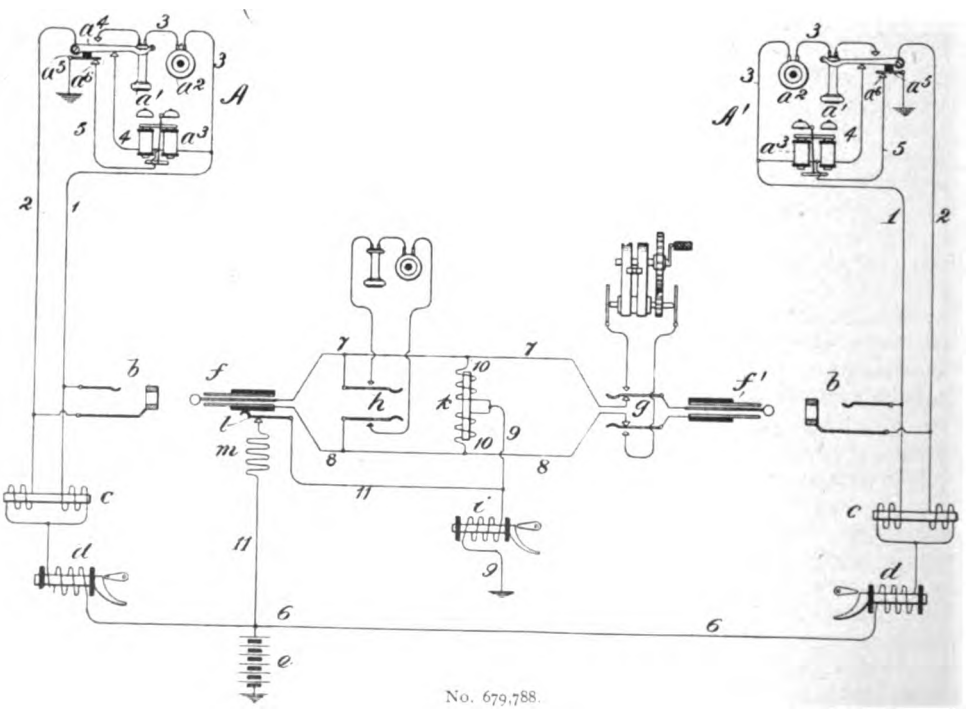
DANIEL SINCLAIR AND WILLIAM AITKEN, OF LONDON, ENGLAND, ASSIGNORS TO WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS. No. 679,788. August 6, 1901. COMMON BATTERY SYSTEM.

This patent embraces a metallic circuit telephone line with a bridge of the line at the sub-station. In circuit with this bridge there is a call bell and a ground branch from the call bell, with a bridge of the line at the central office, which have jointly in the circuit two impedance coils with a line signal, a source of current and a ground branch, the signal being adapted to display its indicator inert. The plugs and plug circuit for making connection between lines of the bridge and the plug circuit with the impedance coils in the bridge. A ground branch from the bridge between the impedance coils and a clearing-out signal in the ground branch, the clearing-out indicator being of high resistance.

This invention is to provide signals and improved modes of operating the same for calling for connection and disconnection.

FRANK R. MCBERTY, OF EVANSTON, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS. No. 680,879. August 20, 1901. TELEPHONE EXCHANGE APPARATUS.

The object of this invention is to provide means by which a single responsive device shall control the different signaling instruments for indicating the signal for connection, as well as for disconnection.



No. 679,788.

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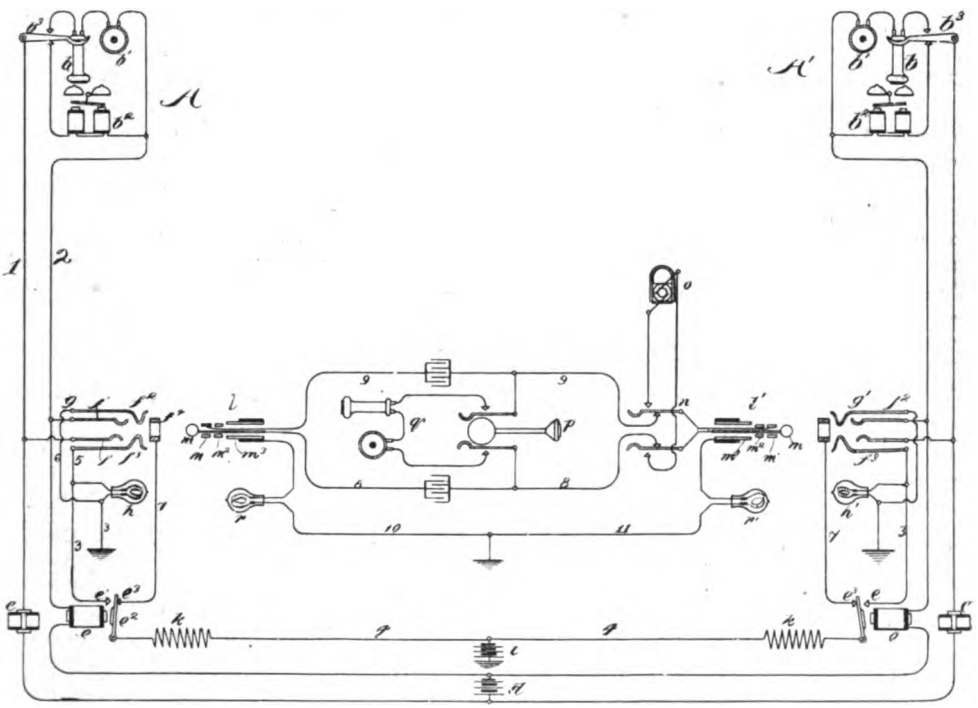
The illustration represents two sub-stations A and A′, connected with spring jacks and a relay in a telephone switchboard, together with the usual appliances for uniting different telephone lines in the switchboard. The apparatus at the sub-stations may comprise a receiving telephone *b* and transmitting telephone b^1, signal bell b^2, and an automatic telephone switch b^3 for connecting the telephone and the bell alternately in the line-circuit. The circuit from station A may be followed, particularly in discussing the apparatus and its mode of operation. Line conductors 1 and 2 extend from the sub-station instruments to the telephone switchboard. Here line 1 is connected, thru an impedance coil *c*, with one pole of a battery *d*, the other line conductor 2 being conducted with the other pole of the same battery thru line relay *e*. The line contacts *f* f^1 of a spring jack *g* in the switchboard are connected with conductors 1 and 2 respectively. A lamp signal *h* is placed near the spring jack *g*. This lamp is included in a conductor 3, of which one end is grounded and the other terminates in the front contact piece e^1 of relay *e*. The lever e^2 of this relay is grounded thru a conductor 4 including a battery *i* and a resistance coil *k*. Two branches 5 and 6 from conductor 3 taken from opposite terminals of the lamp signal *h* terminate in normally separated contact springs f^2 f^3 in the spring jack *g*. The remaining contact piece of the spring-jack contact ring f^4 is connected with one end of conductor 7, the other end of the conductor being fixed to the back contact piece e^3 of the relay.



No. 680,879.

The apparatus at the sub-station A^1 and that connected with the line conductors thereof at the central station are identical with that just described in construction and arrangement.

Connecting plugs *l* *l*′ are furnished for the operator for the purpose of looping different spring jacks together. Each connecting plug comprises four contact pieces *m*, m^1, m^2 and m^3. Of these the first two constitute the line contacts of the plug and are adapted to

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register with the line terminals f f^1 in the spring jack. The contact ring m^2, which is an insulated ring without any conductor extending to it, is arranged to make connection with the two contact springs f^2 and f^3 of the spring jack, and thus to connect them together. The remaining contact piece m^3 is constructed to make contact with the ring f^4. The like line contacts of the two plugs are connected together thru conductors 8 and 9, respectively, which constitute the plug circuit. These conductors include the contact points of a calling key n, which is adapted to disconnect the plug l^1 from its mate and to loop into circuit with it a generator o of signaling current. Branches from conductors 8-9 extend to the switch springs of a listening key p, by means of which an operator's telephone set q may be bridged across the plug circuit. Two grounded conductors 10-11 terminate in the contact pieces 3 of the plugs l and l^1, respectively. Each of these conductors includes a signal lamp, which is associated with the plug in which the conductor terminates, those lamps being designated r and r^1 respectively.

In the idle condition of the apparatus the telephones at the sub-stations rest on the switch hooks b^3. The line circuits are therefore complete thru the high-resistance signal bells, and the current produced in the closed circuit by the battery d is insufficient to excite the relays c. The circuits thru the line signal lamps h are therefore incomplete and the lamps remain unilluminated.

Assume, in order to trace the operation of the system, that subscriber at station A wishes to communicate with subscriber at station A^1. The calling subscriber at station A, by removing his receiver from its switch hook, permits the latter to close the line circuit thru the comparatively low-resistance telephone at the sub-station. Sufficient current is then set up in the line by the battery at the central station to excite the relay, which attracts its armature and closes the branch 4 from battery i to the ground branch 3, including the line signal h. This lamp signal is lighted and thus indicates the call to the attendant at the switchboard. The operator then inserts the plug l into the spring jack g, at the same time throwing the listening key p into position to connect the telephone with the plug-circuit. The operator's telephone outfit q is thus brought into electrical connection with the telephone at station A, and the subscriber is permitted to give his order orally for the connection required. By the insertion of plug l into spring jack g the contact-pieces f^2 f^3 become connected together thru the ring m^2 on the plug, whereby the line-signal h is short-circuited and its indication is effaced. The conductor 10, including the clearing-out signal r, is at the same time connected with conductor 7, so that the clearing-out signal, which is free to respond to current thru it, is substituted for the line-signal and placed in position to indicate further signals in the line. Having received the order for connection with station A^1, the operator inserts plug l^1 into the spring jack g^1 of that line and depresses the plunger of the calling-key n to ring the bell b^2 at the sub-station. The circuit thru conductor 11, including a clearing-out signal r^1, is now complete, since the relay of line to station A^1 is not yet excited, so that the signal r^1 is illuminated. It remains in this condition until the signaled subscriber has responded and removed his receiver from the switch hook. The relay then becomes excited by the current created in the line thru the telephone at the sub-station and draws its armature forward, interrupting the connection between conductors 7 and 4. It will be noted that the line-signal lamp h^1 is already short-circuited. Hence it is not illuminated when the relay-lever closes upon its front contact. If either subscriber replaces his telephone upon its switch hook, the current in that line is interrupted and the line relay at the central station returns to its inert position. The lever of the relay thus closes connection between conductors 4 and 7, completing a circuit to the conductor terminating in the inserted plug, and hence through the clearing-out signal included in that conductor. Thus, if the telephone at station A were replaced upon its hook the local circuit formed would be from bat-

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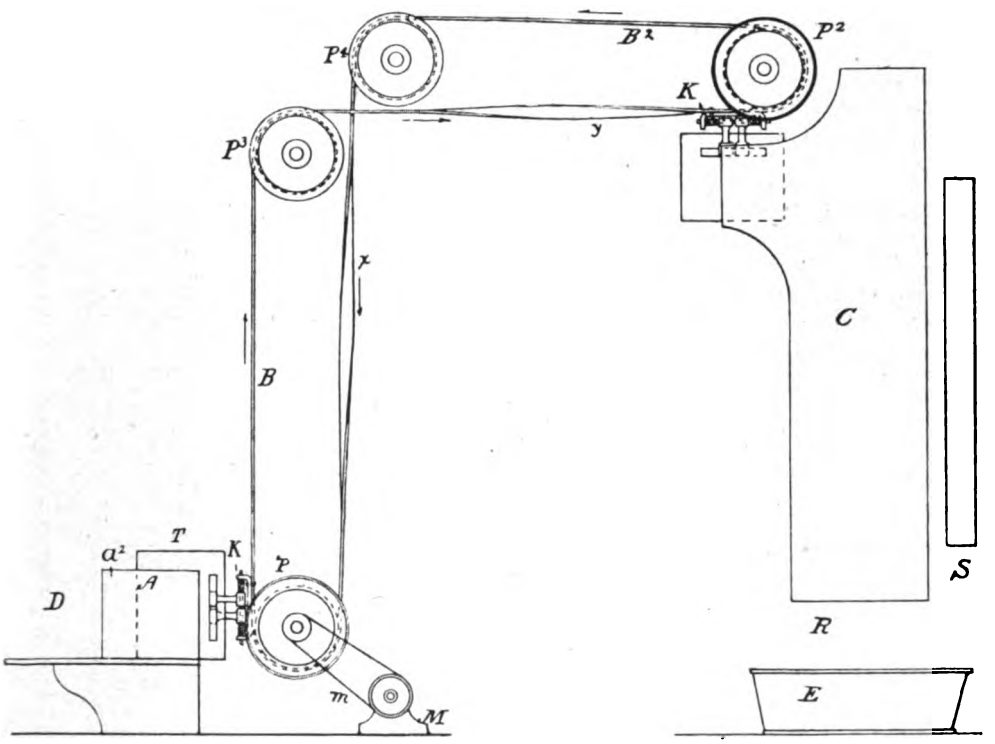
tery *i* thru conductors 4, 7 and 10. The lamp *r* would thus indicate that the line connected with plug *l*, with which the lamp is associated, was no longer in use. When both subscribers have replaced their telephones upon their hooks, both signal lamps *r* and r^1 are illuminated. This condition of the signals is accepted by the operator as signifying that the connection is no longer required. She accordingly removes the plugs from the spring jacks and returns them to their normal positions.



No. 681,603.

GEORGE M. YORKE, OF NEW YORK CITY, ASSIGNOR TO AMERICAN TELEPHONE & TELEGRAPH COMPANY, OF NEW YORK. No. 681,603. August 27, 1901. MECHANICAL INTERCOMMUNICATION BETWEEN TELEPHONE SWITCHBOARDS.

In telephone exchange traffic, messages of a certain class are known as "toll" messages, and require special attention and care on the part of the operating force of the central station or stations concerned, and for these messages a special charge is made. These conditions make it requisite that the names and telephone numbers of the call-originating and called-for sub-stations, together with information as to date, the time of day, and the time consumed in the exchange of conversation or the transmission of the message, shall be entered on a blank form termed the "ticket." This is done, first, to avoid the confusion and liability to error, which, as experience demonstrates, exists if the said information be transmitted orally, as by an order wire between the several operators, and, second, to furnish a record of the transaction for subsequent reference. In the toll or thru business as at present conducted a sub-station or public station desiring a thru connection on first sending in a call in the usual manner is responded to by a receiving operator stationed at the switchboard-section where the call-receiving devices of the line of such sub-station are placed to whom the order for the desired connection is given. The order, with the necessary detailed in-

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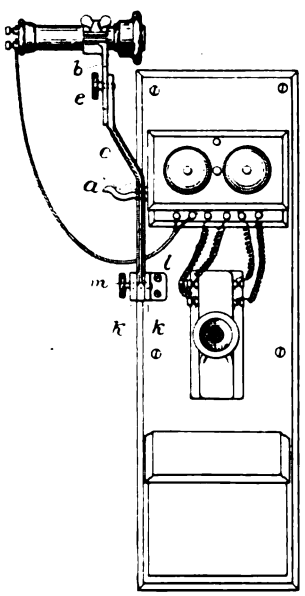
formation, is at once inscribed upon the ticket, and the connection is to be made or completed by a toll or thru line operator at another switchboard or switchboard-section, which may, if desired, be termed the "toll" or "connecting" switchboard. These connecting boards may be arranged at different portions of the central station switchboard apparatus and it thus becomes necessary that the ticket stating the order shall be transferred from the operator who records the order to the particular operator or group of operators that handles the thru lines extending to the distant point with which communication is to be established. The present invention provides efficient and speedy means for the accomplishment of such transfer, and its primary object is to furnish an effective system and a convenient and serviceable apparatus for the accurate and prompt conveyance of the tickets from the switchboard or sections where the orders are received and written or collected or from any determinate distributing point to the particular operator or operators by whom are controlled connections with the thru lines extending to the distant point with which communication is to be established.



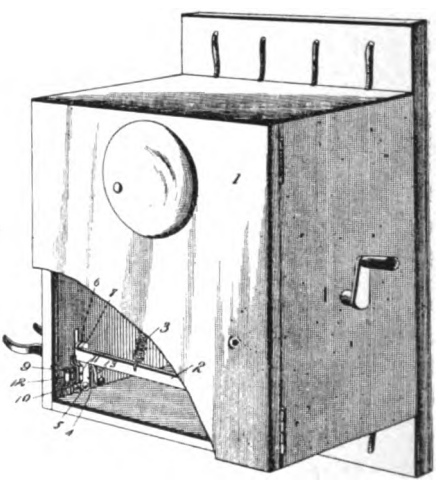
No. 681,408.

E. M. COX AND W. REED, OF PORTLAND, OREGON. ADJUSTABLE ARM FOR SUPPORTING RECEIVERS. No. 681,408. August 27, 1901.

This is an arm for supporting telephone receivers. The illustration shows this device applied to a wall telephone.

ADDINGTON L. BRINCKLE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO BENJAMIN C. FOX AND WILLIAM O. MCCLURG, OF CHESTER, PENNSYLVANIA. No. 681,296. August 27, 1901.

This invention provides for a key to unlock the hook and allow it to make contact so that battery current may be supplied to the transmitter. The switch



No. 681,296.

hook is locked automatically by the hanging up of the receiver. The object of this invention is that only parties possessing a key may use the telephone.

CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE. No. 680,890. August 20, 1901. CONNECTION COUNTER FOR TELEPHONE EXCHANGES.

In accordance with his invention an electro-magnetic counting or registering device is associated with each line, said device having two windings or helices. Line of these windings is included in a circuit which is brought under the control of a relay, which is

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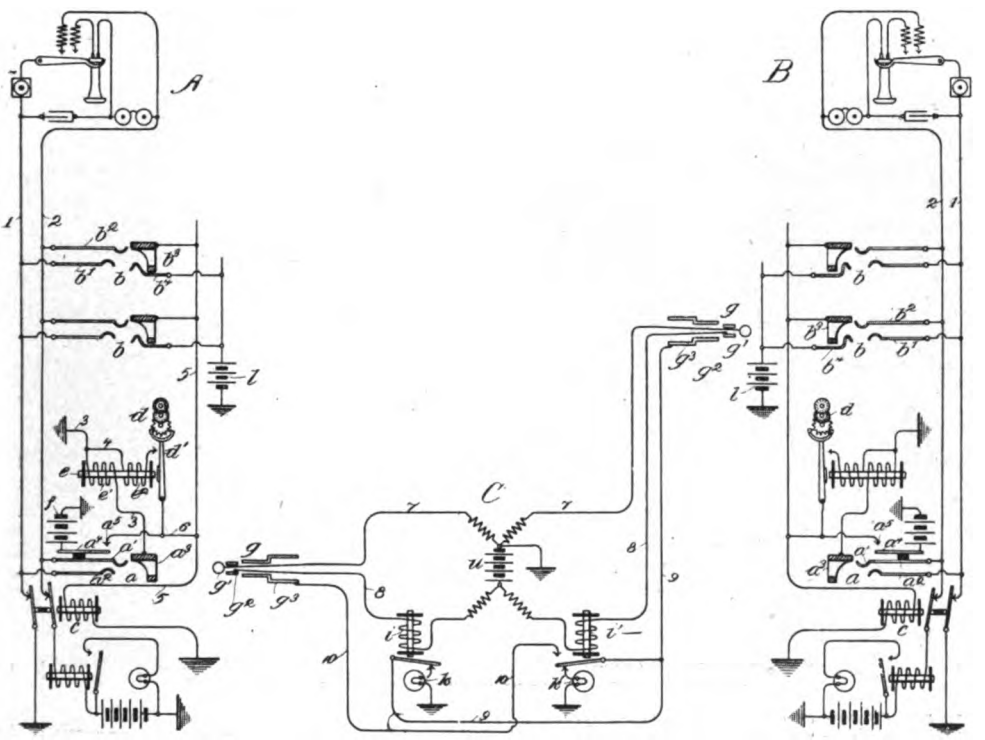
controlled by the flow of current in the called line, whereby the counting mechanism is caused to register the connection when the called subscriber responds. The other winding of the counting device is included in a local circuit which is closed when the counter is operated, so that when the called subscriber responds the counter will operate but once and will thereafter be locked or rendered inert to subsequent changes in the electrical condition of the

FRANK R. MCBERTY, OF EVANSTON, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO. No. 680,880. August 20, 1901.

This invention relates to the measurement of telephone service, and has for its object to provide a connection-register and circuits therefor associated with each telephone line, whereby each call sent in from a sub-station of the line in response to which a connection has been completed to some other line



No. 680,890.

called line. Both of these circuits, which include the windings of the counting device, are preferably controlled by switch-contacts closed by the insertion of the answering plug in the answering spring jack of the calling line, and the circuit which is first completed by the response of the called subscriber preferably derives current from a battery applied thru the medium of a switch-contact on the line-jack of the called line into which the connecting plug has been inserted.

and a response had to the call will automatically be registered.

The circuit including the connection register is formed in part by the usual grounded conductor from the test ring of each jack, which includes the winding of the cut-off relay, and also in part by a third strand of the plug circuit. This third strand has for one terminal the sleeve of the answering plug, which engages with the test-ring of the spring-jack, and for the other terminal the armature of the supervisory relay asso-

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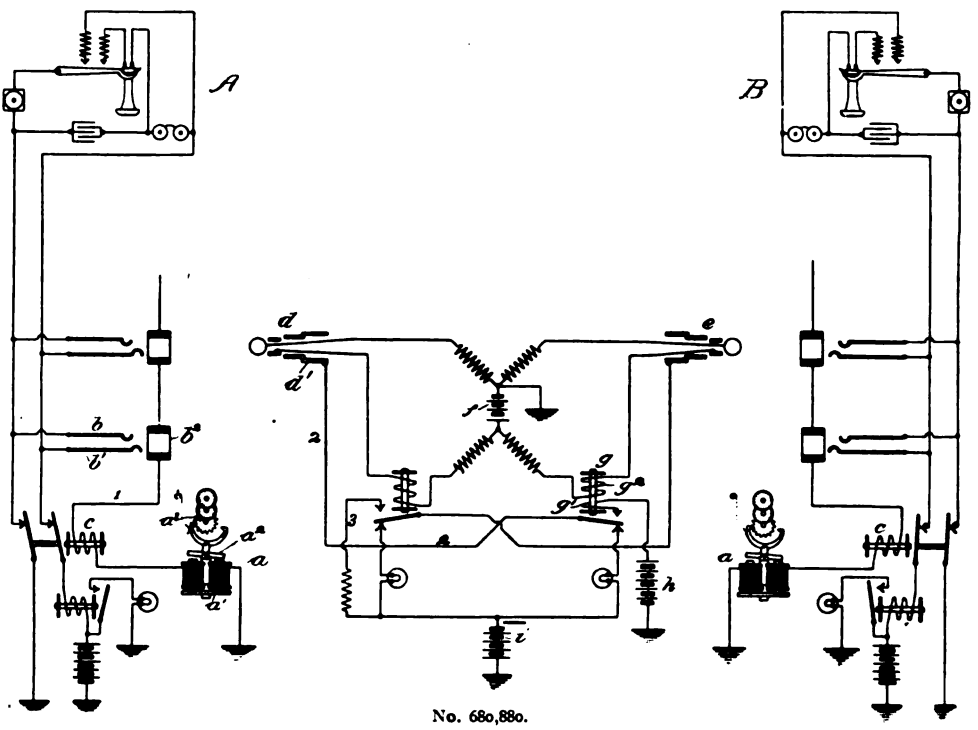
ciated with the connecting or calling plug. From the armature of the supervisory relay two branches may be led to ground, one from the front contact of the relay and one from the normal resting contact thereof. The branch from the back contact of the relay preferably includes a supervisory signal-lamp and a source of current of a given polarity, and the other branch preferably includes a winding of the supervisory relay and a second source of current oppositely directed. It will be seen, therefore, that when connection is made with the spring jack of a calling line there will be a circuit from the grounded battery connected with the back contact of the supervisory relay to the test-ring of the spring jack of the calling line and thence to ground thru the winding of the cut-off relay and the connection-register. When, however, the called subscriber responds, the armature of his supervisory relay is attracted, cutting off the normal branch and substituting therefor the other branch containing the reverse-connected source of current. The current thru the register is thus reversed and the connection recorded. The circuit will thereafter be independent of the called line, because the magnet of the supervisory relay will be energized by the current which is applied when the armature of the relay is drawn up.

Referring to the illustration, a polarized electromagnet measuring or counting device *a*, which requires for its operation two successive oppositely directed current impulses. Connection-registers constructed to operate on this plan are known in the art and consist briefly in a polarized electromagnet a^1, having an oscillating armature a^2, which is adapted to be attracted to one side or the other, according to the direction of current flowing thru the windings of the magnet, and a counting or recording train driven by a star wheel a^3 and an actuating lever operated by the armature of the electromagnet. As the armature is moved from one side to the other, a step-by-step movement of the counting-train is thus produced, and it is evident that a full beat or complete oscillation of the armature lever is necessary in order to advance the counting-train.



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ADVANCEMENT IN AUTOMATIC TELEPHONE SYSTEM.

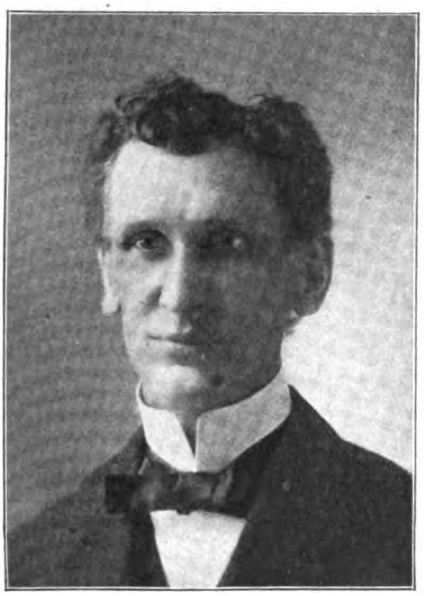
In 1892 the first automatic telephone exchange of any importance was installed at LaPorte, Indiana. The system at that time required seven wires from the central to each subscriber. At that time this system was considered a great invention, and a great amount of capital was expended to promote automatic telephone systems.

In 1893 Mr. John J. Erickson and Mr. Charles Erickson, together with Mr. F. A. Lunquist, perfected the invention of an automatic two-wire system. During this time about twenty exchanges had been installed with automatic devices. These exchanges were not a complete success. Up to 1897 automatic exchanges were called a flat failure. In 1897 Mr. F. A. Lunquist organized the National Automatic Telephone Company for the purpose of manufacturing the Lunquist automatic system, and from January 1, 1898, to January 1, 1900, fifty-four automatic exchanges were installed by the National Automatic Telephone Company, with the Lunquist automatic system. It will be seen that it has taken a great many years to perfect automatic service and bring it to the high standard that it is today. Mr. Lunquist, one of the pioneers in automatic work, in speaking of his latest system, which is now being placed upon the market by the Globe Automatic Telephone Company, of which company Mr. Lundquist is the organizer, says:

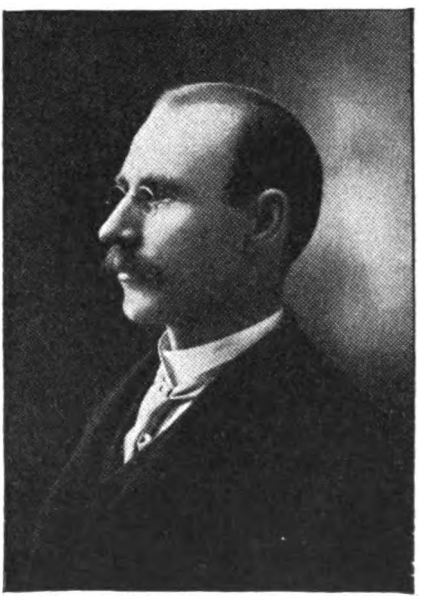
The present system is constructed upon entirely new principles; formerly it was considered necessary to design all parts of the instruments, and especially the switchboards, on the plan of the watch, requiring delicate adjustments and necessarily requiring skill to keep the same in order.

The Globe switchboards are made entirely of steel except where contact is made; every part of the device is formed in gigantic presses and no adjustments whatever are required. The movable parts are hardened steel; thus no possibility of wearing.

The Globe switchboards consist of devices, one for each line, which are exact duplicates of each other. There is no complication of wires, as is found in the manual switchboard. Each device is complete in itself, and to under-



J. E. NORLING.



F. A. LUNQUIST.

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stand one the whole system is understood.

The Globe Automatic Telephone System consists of the ordinary and

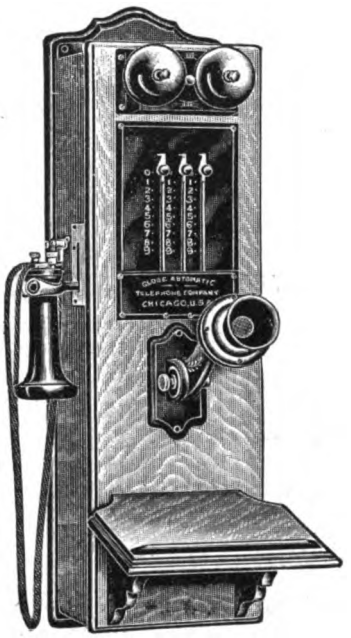

FIG. 1.

usual telephone parts of the very best type. Each telephone is equipped with a keyboard as shown by Fig. 1, by which the subscriber is enabled to select any number desired in the exchange, as well as making connections to lines extending into the country and to other neighboring exchanges.

The keyboard consists of a steel plate, enameled and finely decorated. This plate has three or more key-ways and a movable key for each such key-way. At the side of each key-way are the numerals from 0 to 9; thus to call a number, for instance, 235, all that is necessary is to place the first key to the left on 2, the next on 3, and the next on 5, then take down the receiver, and the conversation is carried on in the ordinary manner. The system is perfect in every detail; for instance, should the desired number be engaged, then the seeking party is immediately notified, and by replacing the receiver upon the hook restores the line to normal position.

The greatest difficulty heretofore has been to provide a means by which the subscriber could call the number wanted correctly. For this purpose has been designed various kinds of clock movements, trains of gears, speed regulators, and various other mechanisms have been resorted to, all of which were more or less uncertain and liable to irregularities, as well as being complicated and difficult for the subscriber to understand.

By the Globe method it will be noticed that the keys are first placed on the numerals which constitute the number about to be called, thus it would be wholly unnecessary to make a mistake, because the number stands in plain view.

There are no mechanisms connected

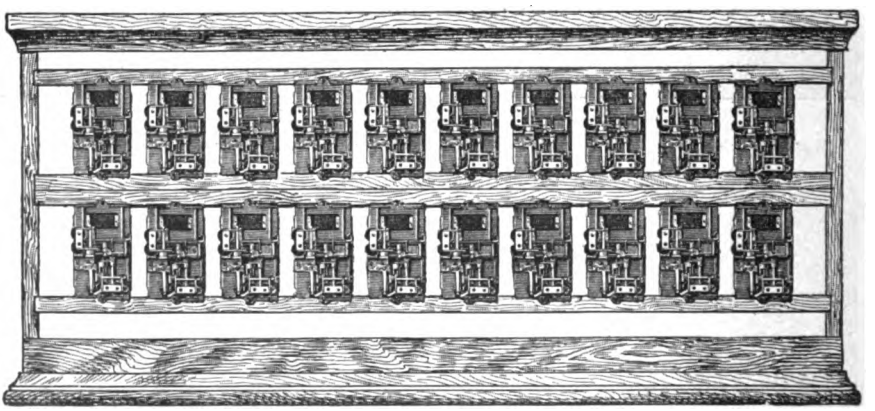

FIG. 3.—SECTIONAL CABINET AUTOMATIC SWITCHBOARD.

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with the keyboard; nothing that the subscriber can dislocate or get out of order by manipulating.

The system is thoroly practical for exchanges of all sizes ranging from five to five thousand subscribers. The principal demand, however, seems to be for exchanges from ten to three thousand. Exchanges now supplying service by operators are readily converted into automatic by their method.

that it has overcome all of the objectionable features of automatic telephony, and that its system now embraces every advantage that is required to entirely displace the "Hello Girl," and dispense with all expense pertaining to the central; that it stands ready to issue a guarantee with each and every estimate, declaring it to perform the duties required to the entire satisfaction of the subscriber and investor.

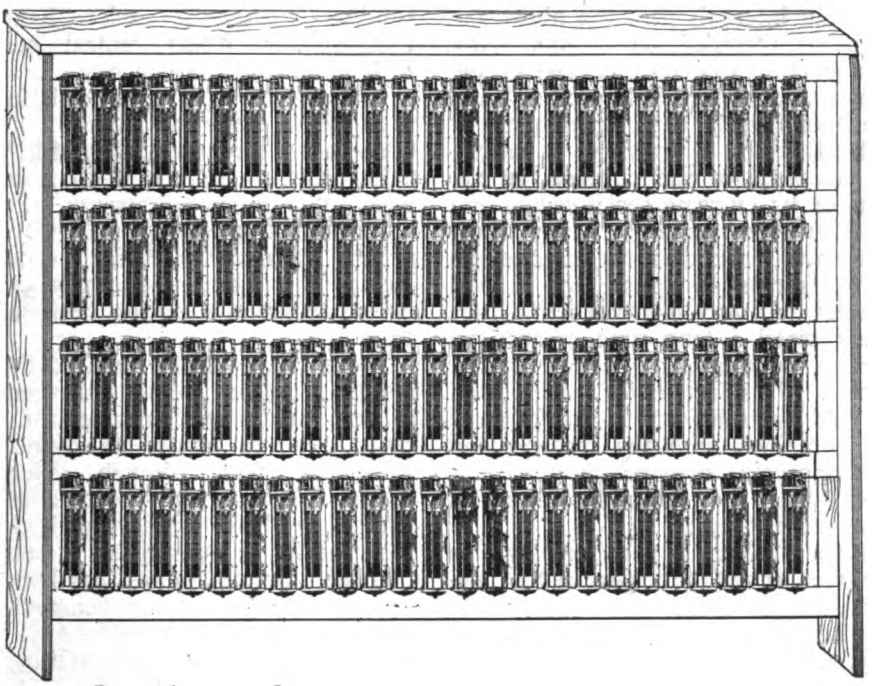

FIG. 2.—AUTOMATIC SWITCHBOARD WITH 100 AUTOMATIC DROPS, 500 CAPACITY.

The company is well supplied with practical men in all its branches. Mr. F. A. Lunquist is the manager, Messrs. John K. Norstrom, superintendent, and John J. Brownrigg, vice-president, respectively, are practical mechanics and inventors of automatic systems. Mr. J. E. Norling, the president, is of unquestionable business ability. Mr. Norling is an extensive mine owner, also principal owner of the *Swedish Tribune*, a thirty-year-old paper, the leading organ of the Swedes of America.

Mr. P. O. Norling, a prosperous business man, formerly of Galva, Illinois, is the secretary and treasurer.

The company desires to announce

PROTECT YOUR TREASURES.

The recent robbing of the vault of the Selby Smelting Company, at Crockett, California, points out the fact that it is necessary to have every protection possible to prevent the removal of valuable material by thieves.

Burglar alarms and other electrical devices, together with the improved locks of today, have lessened the attempts to enter a vault by the ordinary method of entrance and the burglars have been obliged to pursue a different course.

It is very evident that to enter a vault in any way except by the door must take a large amount of patient work,

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all of which must be done in the still hours of the night and must be accompanied with more or less sound. While this sound may not be discernible to the human ear, it can not escape the microphone, which is capable of transmitting the sound of a fly walking on a board. Had the Selby Company's vault been equipped with this microphone attachment, the drilling of the floor could have easily been detected by the watchman, who should listen at the receiver at certain intervals thru the night, the act being recorded on a dial. Any slight sound made on any part of the metal would be faithfully recorded and even intensified by the induction coil.

The Ericsson Transmitter is admirably adapted for the purpose, on account of its extreme sensitiveness and immunity from packing. Many transmitters will work when used frequently, as this serves to agitate the carbon granules, but very few will work after having stood a long time in absolute stillness without first being shaken slightly. This fact leaves the Ericsson in a field by itself for this class of work and, combined with the receiver and other apparatus of equal merit, makes an equipment that can be thoroly relied on in every instance.

Further information concerning this apparatus or anything else in the telephone line can be had by writing to the office of the Ericcson Telephone Company, 296 Broadway, New York city.

AMERICAN PROSPERITY.

In a recent editorial in one of Chicago's dailies attention was called to the phenomenal growth and success of the independent telephone movement, mentioning that at last even one of the large cities, Philadelphia, had contracted for an independent telephone plant. It may be of interest to our readers to learn that the American Electric Telephone Company secured the contract for practically the entire equipment, with the exception of the switchboard, the balance of the apparatus including eight thousand No. 34 central energy telephones, 10,000 terminals and all other necessary protective devices. This is undoubtedly one of the largest contracts secured by an independent manufacturer. The reason for non-acceptance of the switchboard part being that owing to the large number of previous contracts under construction, the board could not have been completed within the time limit.

Harrisburg is another important city in Pennsylvania to adopt American apparatus. The exchange will have 2,000-line capacity and provision for 3,000; two small adjoining towns will have 500-line exchanges each; Reading, Pennsylvania, 1,500 central energy, with 5,000 ultimate capacity.

In New Jersey, Trenton falls in line with 3,000 American central energy. Ohio is well represented with Mansfield, common battery 1,200 installed, with 3,000 ultimate capacity. Zanesville, Ohio, 1,500 Common Battery connected, with provision for 3,000. In Xenia, Ohio, the new exchange is running with 800 in operation, designed for 2,000.

Texas has evidently realized the necessity of modern methods of communication. Austin has contracted for 1,200 central energy immediate connection. 3,000 ultimately. Temple, Tyler and Taylor, Texas, each 750 lines, central energy, ready to connect with double the capacity as subscribers increase in number. Belton, Texas, has bought a 500-line equipment, for common battery, can increase to 1,000.

Oklahoma City, Indian Territory, the growing city, has already 750 subscribers on a 1,200-line central energy switchboard. Topeka, Kansas, the progressive Western city, will install 1,200 lines at once and provide for a certain increase up to 3,000. Rhinelander, Wisconsin, will start with nearly 750 subscribers on a 1,200-line board. In Illinois, Pekin swells the list with a 750 to 1,200 line exchange, while in Huntington, Indiana, a 1,000-line equipment is contracted for and construction under way.

THE Electric Appliance Company has just placed upon the market a new cabinet type wall telephone for both series and bridging work. Special descriptive matter is being sent upon application.

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TELEPHONE NEWS.

ARKANSAS.

GREEN FOREST, ARK.—A telephone exchange is in operation at Green Forest.

MONTICELLO, ARK.—Monticello is connected by telephone with Little Rock, Pine Bluff, Monroe, Louisiana, and all intermediate points, and has a very satisfactory local exchange which is widely patronized.

OZARK, ARK.—Articles of incorporation of the Home Telephone Company, of Ozark, were filed with the Secretary of State. The capital stock is $25,000, all of which has been subscribed. The officers are William Quaile, president; L. R. A. Wallace, vice-president; Tom Carter, secretary; George W. Russell, treasurer.

TEXARKANA, ARK.—A franchise has been granted to S. F. Richardson and others for thirty years. The rate shall not exceed $36 and $24, and the exchange must be in operation within eighteen months.

CAROLINAS.

COLUMBIA, S. C.—The South Carolina Long-Distance Telephone Company, Columbia, South Carolina, has now reached twenty-three towns thruout the State where subscribers numbering 1,595 have been secured. The company started out with the purpose of connecting Columbia with the principal cities of the State. Extensions will be made to other towns.

FOREST CITY, N. C.—The Forest City Telephone Company has been incorporated at Forest City, North Carolina, with a capital stock of $10,000. J. N. Moore, C. R. Simmons, W. W. Pool, D. E. Young and others are the incorporators.

RALEIGH, N. C.—Two new telephone lines are being constructed in the eastern part of the State. One will extend from Morehead City to Goldsboro, and the other from Henderson to New Bern via Rocky Mount. These lines, which will place in closer touch the people of Eastern and Central Carolina, are being constructed by the Henderson Telephone Company and the Carolina & Virginia Telephone Company. These two companies now own jointly 1,200 miles of telephone lines in the State.

CALIFORNIA.

MODESTO, CAL.—The Sunset Telephone Company is running its lines thru the valley along the Santa Fe right of way.

SAN FRANCISCO, CAL.—A private exchange system will soon be in operation in the custom house and appraiser's building. There will be connections with twenty-eight federal offices.

DELAWARE.

DELAWARE CITY, DEL.—The Diamond State Telephone Company has completed its line in Delaware City.

DOVER, DEL.—The Diamond State Telephone Company is about to lay a cable across the Chesapeake Bay from Love Point on the eastern shore to Sandy Point Lighthouse on the western shore, connecting with the Chesapeake & Potomac Telephone Company. It will be five miles long and will weigh 70 tons. The deepest point along its bed will be seventy feet below the surface of the water.

GEORGIA.

ATLANTA, GA.—A new and more direct telephone line to New York has been opened up. It shortens previous telephone routes by 150 miles. The new line is by way of Charlotte, which now has direct communication with Atlanta. Rates have been reduced from $10 to $5.75 during the day and $2.90 at night for three-minute tolls.

ATLANTA, GA.—Standard Telephone Company, 104 Edgewood avenue, will remodel and improve its entire plant, installing new machinery, etc., at a cost of $8,000.

CAMILLA, GA.—T. R. Bennett, L. A. Bush, M. E. Bush and F. L. Lewis have applied for incorporation of Camilla Telephone Company. Telephone franchise has been secured.

COVINGTON, GA.—Covington Telephone Company, organized with C. C. Brooks, president, has commenced work on construction of its proposed system.

IRWINTON, GA.—A new telephone line is now in course of erection between this place and Milledgeville, a distance of twenty-two miles. Mr. A. I. Smith is the owner and builder. He has just completed a line from Irwinton to Toombsboro and Dublin, connecting with the local exchange in the latter place.

INDIAN TERRITORY.

ARDMORE, I. T.—Mr. Hummer, of Roff, president of the Arkansas Telephone Company, has received a permit from the Secretary of the Interior to build a line of telephone from Stroud, Oklahoma, to Sapulpa, Creek Nation, from South McAlester to Shawnee and from Hartshorne to Ardmore.

MARIETTA, I. T.—The telephone line from Marietta to Burneyville, I. T., has been completed. This is part of the proposed line of the Red River Company, which will run from McAlester to Ryan on the Rock Island. It is said the construction of the line is to be rushed.

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IDAHO.

BOISE CITY, IDAHO.— Certificate of increase of the capital stock of the Idaho Independent Telephone Company from $100,000 to $500,000 has been filed, and is made for the purpose of extending the company's lines.

PAYETTE, IDAHO.—The Payette Telephone Company has been organized by A. B. Moss, Peter Pence, W. A. Coughanour, James A. Lauer, B. P. Shawhan, D. C. Chase, E. Zimmerman, J. R. Banks and C. E. Brainard. The capital stock is $5,000, all subscribed. Sixteen miles of wire and poles have been ordered. This company was formed for the purpose of building to meet the Idaho Independent Telephone Company's line coming from Pearl.

ILLINOIS.

ALTON, ILL.—The Kinloch Telephone Company will begin the work of constructing its telephone system in Alton.

BECKFORD, ILL.—The Lee County Telephone Company will install a new automatic pay telephone at the assembly near the upper gates for the use of the public.

CHARLESTON, ILL.—The Charleston Telephone Company, owners Messrs. Brooks and Cadle; manager, F. A. Brooks, now has a switchboard of 415 drop capacity and 325 subscribers. It operates two hundred miles of local circuit and forty of toll line.

CHICAGO, ILL.—The Western Electric Company, of Chicago, has filed a petition in the United States Court at Columbus, asking that the Citizens' Telephone Company, Henry A. Lanman and Frank L. Beam, be enjoined from using and distributing a certain signal apparatus, which, it is claimed, is an infringement on patents owned by the plaintiff.

CHICAGO, ILL.—The nickel-in-the-slot telephone, which has lately been placed in police stations, has been declared a failure by Inspector Max Heidelmeier of the North Side. When an employe of the telephone company went to the Chicago avenue police station to collect the money which should have been in the repository to pay for calls he found pieces of flattened brass.

CHICAGO, ILL.—The Victor Telephone Manufacturing Company, of Chicago, Illinois, has changed its name to the International Globe Company, and will now manufacture and print maps instead of engaging in the electrical business.

CHICAGO, ILL.—The La Salle Electric Company has been formed; capital, $9,000; manufacturing and dealing in electrical supplies. Incorporators: P. L. Biggins, L. J. Gamwell, E. M. Hanes.

CHICAGO, ILL.— Melvin E. Richardson, president of the National Automatic Telephone Company and one of the creditors of the concern, asked the Circuit Court to appoint a receiver for the company. He complained that it is in debt to the amount of $13,000 and that unless a receiver is appointed to take charge of its stock and machinery at 153-155 West Jackson boulevard, the usefulness and value of the assets will be lost. Certain patents which are said to be of great value are also involved.

CHICAGO, ILL.—The Eureka Telephone & Construction Company, Chicago, Illinois. Capital stock, $50,000. Incorporators: H. R. Platt, J. H. Rollins and Sydney Stein.

CHICAGO, ILL.— Mr. S. C. Platt, the representative of the Kellogg Company, of Chicago, the largest independent manufacturers of telephone apparatus in the country, has been in Richmond and closed a $50,000 contract with the Richmond Telephone Company for a new switchboard and telephones thruout.

FAIRBURY, ILL.—A local telephone company has been organized at Fairbury and has secured a franchise which stipulates the cost of the service to citizens wanting to use the telephones. The reason for the organization of this new corporation is said to be because the present company, the Peoria & Eastern, raised its prices to the users of the 'phones and have the patrons sign contracts and hence the starting of the new enterprise which many users of the 'phone are backing up.

FITHIAN, ILL.—The Fithian Telephone Company has completed its toll line to Ogden.

GENESEO, ILL.— Increasing patronage of the Mutual Telephone lines necessitates placing in a new switchboard and adding another operator, which the management is arranging to provide.

HUMBOLDT, ILL.— Humboldt Telephone Company, Humboldt. Capital stock, $2,500; telephone system; incorporators, James McDougle, S. C. Ashbrook, E. M. Mulliken.

HAMPSHIRE, ILL.—A new telephone line is being erected between Hampshire and Burlington.

KANKAKEE, ILL.—The telephone business at Kankakee is booming. The company there has 620 subscribers and more coming. The boom has been caused by cheap party-line rates and also cheap house rates.

LAKE FOREST, ILL.—The Telephone Company is putting in a new switchboard at its office here, and when completed will equip each patron with a long-distance metallic circuit set.

MOUNT CARROLL, ILL.— Frank Zinnel, proprietor of the Independent Telephone Company, has transferred a lot of poles and wire to Sabula, and is ready to put in an exchange at that place. Mr. Zinnel has hopes of extending his line to Cedar Rapids.

MACOMB, ILL.—The Kurtz Telephone Company was granted a franchise to enter the city and operate an exchange. The owner expects to completely cover the country within a radius of sixty-five miles by uniting all the lines around here except the Bell line. He will furnish a 'phone at 25 cents a week, and now has something over 225 subscribers. He gave the same terms to the city as the present company — the use of two 'phones within a radius of sixty-five miles.

MORRISON, ILL.—Whiteside County Telephone Company, Morrison; capital stock,

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$120,000; incorporators, Harry L. Hall, Walter W. Warner and Albert R. Baird.

MACOMB, ILL.—The National Telephone Company has a thirty-year franchise and is incorporated with a capital stock of $20,000. Object, to consolidate all independent companies and form a merchants' line.

PEORIA, ILL.—The new telephone company in Peoria, Illinois, is obtaining many new subscribers.

PEORIA, ILL.—The Central Electric Company; capital stock increased from $5,000 to $25,000.

SPRING VALLEY, ILL.—The Bureau County Telephone Company is now engaged in running a line into Mineral.

SPRINGFIELD, ILL.—An independent telephone company which has been operating in Pekin, Lincoln and neighboring cities, is endeavoring to secure a franchise in this city. A few years ago a local company was organized for the same purpose, but it allowed its franchise to lapse, and the effort died out.

SIDNEY, ILL.—The Home Telephone Company, of this place, is extending its lines. Improvements to the extent of $1,000 will be made, making a total of about $4,000.

STRATFORD, ILL.—The telephone company has adopted the wireless system in this town.

STERLING, ILL.—The Whiteside Harrison Telephone Company is rebuilding its system. About $25,000 will be expended. A central energy plant is being installed.

SALEM, ILL.—A telephone exchange is being put in at Sandoval, Illinois, by the Salem Telephone Company.

TAYLOR RIDGE, ILL.—Farmers' Independent Trunk Telephone Association, Taylor Ridge; capital stock, $2,500; operate telephone system; incorporators, Peter Eckhardt, W. H. Miller, A. A. Buffum.

TREMONT, ILL.—The Tremont city council has granted A. J. Davis the right to construct and maintain another telephone system in this city.

WILLIAMSBURG, ILL.—Mr. C. A. Gregory is erecting a metallic telephone line to Williamsburg and Fairbanks.

WEST POINT, ILL.—I. P. Kilgore has organized a telephone system to extend thru the neighborhood about five miles west of this town.

IOWA.

AFTON, IOWA.—The Afton Mutual Telephone Company has built a new line to Arippe.

AFTON, IOWA.—The Mutual Telephone Company, of Afton, Iowa, has been incorporated, with a capital stock of $5,000.

CHARITON, IOWA.—The Chariton & Benton Telephone Company now comes into Chariton thru the central switchboard. This ends all opposition to the Chariton company, which is giving excellent satisfaction to its patrons.

DAVENPORT, IOWA.—The Iowa Telephone Company has completed its system of underground lines in Davenport, and now has about 7,000 feet of conduit.

DES MOINES, IOWA.—The Mutual Telephone Company, of Des Moines, Iowa, has planned to resume putting down underground conduits for its wires this fall.

DES MOINES, IOWA.—The Rex Telephone & Electric Company, of Des Moines, is to increase its plant. This improvement has been rendered necessary by increasing business.

GRUNDY CENTER, IOWA.—The Grundy County Telephone Comany has been incorporated at Grundy Center, Iowa, and will install a local exchange. Eventually the company plans to cover the entire county. The capital stock is $10,000.

HOPKINGTON, IOWA.—The Hopkington Telephone Company, Hopkington, has increased its capital stock from $3,000 to $10,000.

KNOXVILLE, IOWA.—The Knoxville Telephone Company has just expended $3,000 in repairs and improvements to its system.

MCGREGOR, IOWA.—The Standard Telephone Company is arranging for the new line to Clayton.

MOUNT AYR, IOWA.—The Mount Ayr Mutual Telephone Company has been incorporated, with $5,000 capital stock.

MYSTIC, IOWA.—The Centerville Telephone Company of Centerville, Iowa, will install a local exchange for Mystic, Iowa.

MOUNT PLEASANT, IOWA.—This city will soon have the new Olds telephone line connections. The line is being built south thru Swedesburg and a couple of miles south of Swedesburg a spur is being put up to Trenton.

NEWTON, IOWA.—The new exchange at Newton, Iowa, has been completed and put in operation.

NORTH BRANCH, IOWA.—A telephone line is completed from North Branch to Adair, Iowa.

OTTUMWA, IOWA.—Amended articles of incorporation were filed by the Ottumwa Telephone Company, increasing its capitalization from $75,000 to $120,000. The amended articles also provide for a president, vice-president, secretary and treasurer. A board of directors will consist of five stockholders and of these three will be appointed as an executive committee. The annual meetings are changed from the first Monday in January to the second Wednesday in April.

ONAWA, IOWA.—The Monona Telephone Company has completed its new line from Onawa to Blencoe, which gives two lines between the places. This completes their work for the present. During the summer they have put in about fifty miles of telephone lines in this vicinity, and most every town in the county is now connected with the county seat.

TYNDALL, IOWA.—The new telephone line between Tyndall and Tabor and Bonhomme is completed. Bonhomme will be much benefited owing to the fact that the town is off the railroad.

VINTON, IOWA.—Fire destroyed the entire equipment of the Iowa Telephone Company in Vinton, entailing a loss of probably $2,000. The fire was set by lightning. The two rooms

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occupied were wholly burnt out, but the fire department saved the rest of the building.

WAUCOMA, IOWA.—Charles Webster, of Waucoma, Iowa, has sold another block of his telephone stock, covering his holdings in the exchanges at Mason City, Charles City and Osage, Iowa, and about 430 miles of toll line. The purchasers are Thomas A. Way, T. A. Potter and others of Britt, Iowa.

INDIANA.

CHURUBUSCO, IND.—Mr. Virgil A. Geiger owns and operates a telephone in connection with his newspaper, *The Truth*. The capital stock is $10,000; switchboard capacity, 100 drops; subscribers, 145, on complete metallic circuit. He has fifty miles of toll line, and extensions are projected.

ELKHART, IND.—The Home Telephone Company, of Elkhart county, has its 425 miles of line assessed $100 per mile.

GLENN HALL, IND.—The Odell Telephone Company, of Glen Hall, filed articles of incorporation with the Secretary of State, stating capital stock to be $10,000. The company intends to maintain and operate telephones and exchanges in Tippecanoe, Montgomery and Fountain counties. The stockholders are Samuel B. Lutz, William B. Foresman and Harry G. Lutz.

GLEN HALL, IND.—The Odell Telephone Company has been formed; capital stock, $10,000. Directors: Samuel B. Lutz, H. G. Lutz and W. B. Forsman.

INDIANAPOLIS, IND.—Fifteen independent telephone companies in northern Indiana are said to be preparing to consolidate under one financial management, tho each is to retain its local individuality, with its local board of directors.

INDIANAPOLIS, IND.—The Combination Telephone Directors' Company, Indianapolis, Indiana. Capital stock, $5,000. Directors, B. C. Wheat, E. L. Donohue and Charles Darling.

LYNN, IND.—The Lynn Local Telephone Company, which was recently incorporated, has been organized, and is now beginning business. It is using Stromberg-Carlson apparatus. The officers of the company are S. C. Bowen, president; Daniel Hecker, treasurer, and W. E. Henshaw, secretary.

LOGANSPORT, IND.—The franchise for the Logansport-Fort Wayne Telephone Company, an independent organization which is seeking to enter the field, was not granted at a meeting of the common council. The matter will be considered at a special session. The councilmen appear to be favorable to the new company.

LOGANSPORT, IND.—Theodore Thorward, representing Fort Wayne capitalists, submitted to the city council a petition for a fifty-year franchise to build an independent telephone plant to compete with the Bell. The prospects for a grant are good. Councilmen favor but one exchange, and as the Central Union's franchise expires in January, a petition for a renewal will likely be denied.

MULBERRY, IND.—The People's Telephone plant is now in operation at this place.

MONTICELLO, IND.—The Monticello Telephone Company, Monticello, Indiana, has increased its capital stock from $5,000 to $30,000.

PARKER, IND.—The Parker Telephone Company has been incorporated, with a capital stock of $2,500. The headquarters of the company will be here, and it will operate in Randolph, Delaware, Jay and Henry counties. The directors are Alvin Miller, C. F. Halliday, L. A. Botkin, A. G. Rodgers, N. T. Chenoweth, T. A. Condon and Samuel Jones.

SOUTH BEND, IND.—South Bend, Indiana, is to have an independent telephone company in a short time to compete with the Central Union plant, now in operation. Over 400 subscribers have already signed for telephones, and the promoters believe this number can be doubled in a short time if an effort is made. The plant will be an up-to-date one in every respect.

SEYMOUR, IND.—Jacob Baldwin and John Fox have secured the right of way for a new line from Reddington to Seymour, which will be built in a short time.

KANSAS.

BELOIT, KAN.—The telephone system is just nearing completion.

LEAVENWORTH, KAN.—The People's Telephone toll lines are now open for business to Platte City, Weston and Beverly, Missouri.

MANHATTAN, KAN.—The J. H. Mahan Independent Telephone Company, the Salina Independent Telephone Company and the Wareham-Wood Telephone Company, of Manhattan, have incorporated under the name of the Kansas Union Telephone Company; capital stock, $100,000.

RILEY, KAN.—The telephone people are working on a line from Bala to Riley, and it will soon be completed.

TOPEKA, KAN.—The Wilson County Telephone Company has been incorporated; capital stock, $750.

TOPEKA, KAN.—The city council, by a unanimous vote, granted a franchise to the Pankey Telephone Company, because of the fact that a very large number of the principal business men of Topeka had petitioned for it, the inference being that in the opinion of Topeka's business men another system was necessary.

TOPEKA, KAN.—The Topeka & El Reno Telephone Company, Topeka, Kansas. Capital stock, $10,000. Directors: W. F. Evans, Topeka; H. B. Low, Fort Worth; F. H. Wright, G. W. Bellamy and O. O. Blake, of El Reno.

KENTUCKY.

LEXINGTON, KY.—The United States Investment Company, of Lexington, filed suit here to foreclose its lien of $6,000 against the Anderson County Telephone Company. This company was organized a year or so ago in opposition to the East Tennessee Company.

LOUISVILLE, KY.—Louisville Home Telephone Company has had plans made by J. J. Gaffney for erection of and commenced work on a three-story brick and stone building to cost $30,000; also let contract for

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switchboard of 12,000 capacity, with 6,000 installed.

OWINGSVILLE, KY.—The city council has granted a franchise to the Home Telephone Company to erect its telephones and wires in the streets of the city.

MAINE.

BOLSTER MILLS, ME.—The Bolster Mills Telephone & Telegraph Company, to do a telegraph and telephone business; capitalized at $2,000.

WEST PARIS, ME.—The Eastern Telephone Company has been granted the right to set its poles in Lewiston, and the line will soon be extended to this village. It will connect with the local wires in Paris, Sumner, Woodstock and Greenwood.

MASSACHUSETTS.

BOSTON, MASS.—A certificate of incorpotion has been filed in Dover, Delaware, for the New Storage Battery Company, of this city, capital stock, $1,000,000.

MINNESOTA.

BRYCELYN, MINN.—The Blue Earth Valley Telephone Company will install a local exchange for Brycelyn, Minnesota.

BRAINERD, MINN.—The local telephone company at Brainerd, Minnesota, has agreed to reduce residence connections to $1 a month, if the application of the Iron Range Telephone Company for a franchise there is refused. The latter proposed rates of $1 for residences and $2 for business houses. The home company claimed there would not be sufficient income on the basis of $2 a month for business connections.

CROOKSTON, MINN.—Work has been started rebuilding a local exchange here.

GLENCOE, MINN.—Manager J. J. Greaves, of the Glencoe Telephone Company, is putting up a line on the Lake Marion and Plato roads, which will give farmers living on the roads the opportunity to have a 'phone put in their homes. So far, about twenty-five instruments have been subscribed for and it is expected that a great many more will be placed in farmers' houses as soon as the line is completed.

LE SUEUR, MINN.—The Sibley County Telephone Company has extended its line to Le Sueur, Minnesota, and will make its headquarters there hereafter.

LUVERNE, MINN.—The Edgerton Telephone Company has been granted admission to Luverne.

MANKATO, MINN.—The Mankato Citizens' Telephone Company have the toll line completed to Garden City township.

MINNEAPOLIS, MINN.—The committee on underground wires recommends that the petition of the Twin City Telephone Company for permission to lay underground wires be granted.

MINNEAPOLIS, MINN.—The city hospital has just been equipped with a complete intercommunicating telephone system, connected with the Twin City Telephone Company's exchange. The switchboard at the hospital is similar to the one recently installed at the courthouse.

MINNEAPOLIS, MINN.—The Twin City Telephone Company will have a complete switchboard exhibit at the Minnesota State Fair in working order. There will be numerous instruments on the grounds and a connection with either St. Paul or Minneapolis can be had for 5 cents.

MINNEAPOLIS, MINN.—The Twin City Telephone Company, of Minneapolis, has filed a mortgage in that city running to the Royal Trust Company, of Chicago, for $1,000,000.

ORTONVILLE, MINN.—The Northern Electric Telephone Company is rebuilding its exchange at Ortonville, Minnesota.

PARK RAPIDS, MINN.—The Park Rapids & Eastern Telephone Company has built a line from Park Rapids, Minnesota east.

PIPESTONE, MINN.—A large addition to the switchboard at the local telephone exchange has been installed. It was necessitated by the large number of new 'phones which are continually being put into service.

WINONA, MINN.—The Winona Telephone Company is just completing extensions and improvements at an expense of about $2,500, increasing the number of 'phones having direct connection with the Winona exchange to nearly 1,000. Twenty-five farms between Altura and Minneiska have been given telephone connection, and a line is now being finished from Witoka to Pickwick and La Moille that will add as many farms to the exchange. The Winona company was the fourth independent company to be established in the United States, and has grown steadily.

MARYLAND.

BALTIMORE, MD.—The Enterprise Telephone Company's lines in Montgomery and Prince George's counties are to be extended and to have connection with the Chesapeake & Potomac's long-distance lines. Long-distance transmitters will be placed on all of the former company's stations, including those in private residences.

MISSOURI.

AUSTIN CITY, MO.—The Austin City Telephone Company amended its charter, increasing its capital stock to $200,000.

GREENE COUNTY, MO.—Greene County, Missouri, is said to have the only Farmers' Mutual Telephone Association, systematically and equitably organized and operated, in the State.

HANNIBAL, MO.—Harvey J. Riley, of Palmyra, and Henry G. Glascock, of this city, are engaged in placing in position the new switchboard of the Miller Township & Hannibal Telephone Company. Nearly all the poles are erected, and the wire extends from Palmyra and West Ely.

SPRINGFIELD, MO.—A telephone line is to be constructed from Mammoth Spring to Springfield, Missouri.

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PLATT CITY, MO.—The People's Telephone toll line is now open for business to Platte City, Weston and Beverly, Missouri.

MICHIGAN.

CARLTON CENTER, MICH.—The Citizens' Telephone Company strung wires and put in 'phones to Carlton Center, and are working at Freeport. The company is having wonderful success, and will soon project a line to Battle Creek and Kalamazoo.

DETROIT, MICH.—The Oakland County Telephone Company has been obliged to substitute cables in the place of bare wires in the alleys in the business portion of the town. Within the past four months one hundred subscribers have been added to the list, and there is constant demand for more telephones. The list has now almost reached the five hundred mark.

DETROIT, MICH.—The Michigan Telephone Company is preparing to extend its lines from Bay City to Alpena, Mackinaw City and all large intermediate towns.

DETROIT, MICH.— It was announced when the People's Telephone Company started to get subscriptions for a system in Detroit, Michigan, that no charge would be made for service until the company had a list of at least 3,500 subscribers. Altho the exchange will not be completed until next year, the company has obtained nearly that number, and it is now expected that the exchange will start business with about 5,000 subscribers.

HOWELL, MICH.—The common council has granted a franchise to R. Bruce McPherson and associates for the purpose of constructing, operating and maintaining a telephone system in this village. Mr. McPherson says a strictly up-to-date plant will be installed, using copper metallic circuits and long-distance instruments, and that it is the intention of the company to extend their lines to all parts of Livingston county and connect with the toll lines being built out of Detroit.

HOWELL, MICH.—The exchanges of the Michigan and the New State telephone systems at Howell have been consolidated under one management.

HART, MICH.—The Oceana Telephone Company, of Hart, Michigan, has sold to the Pere Marquette Telephone Company, of Ludington, Michigan, that portion of its telephone property located in Mason county.

JACKSON, MICH.—The People's Telephone Company, of Jackson, Michigan, has made a contract for the erection of a building at Jackson. The capital stock of the company has been fixed at $200,000. Among the directors are J. C. Richardson, Z. C. Eldred and others.

MARQUETTE, MICH.—The Michigan Telephone Company has completed a large amount of underground work for its rebuilt exchange at Marquette, Michigan, and is about to cut over a modern switchboard there.

SARANAC, MICH.—The Citizens' Telephone Company is extending its line from Lowe to Keene Township.

WASHINGTON, MICH.—The Valley Telephone Company has been given permission to erect poles on North Sidney, from Washington to Jefferson.

WINDSOR, MICH.—The Windsor council would like to have the telegraph and telephone companies place their wires underground before the business streets are paved with asphalt, but have no authority to force the companies to do so. Cedar poles will be substituted with iron for electric light.

WOLF CREEK, MICH.—Articles of incorporation have been filed with the Secretary of State by the Farmers' Telephone Company, of Wolf Creek, with a capital stock of $2,000.

WYANDOTTE, MICH.—The People's Telephone Company was granted a thirty-year franchise in this city.

MISSISSIPPI.

GREENWOOD, MISS.—The charter of the Yazoo Valley Telegraph & Telephone Company has been approved; capital stock, $150,000. The incorporators are Harvey Myers, F. C. Smith, C. E. Wright, W. D. Crist, A. F. Gardner and W. T. Rush.

TUPELO, MISS.—The citizens of Tupelo are soliciting independent telephone companies to install an exchange in that city. Complaints are being made that the Cumberland (Bell) Company's rates are too high for the service given. The city owns the electric light plant, and some of the citizens are urging the city to build and own a telephone exchange. Such an action would be a novel feature in that section of the country, as it would be the first telephone exchange under municipal control.

NEW JERSEY.

BAPTISTOWN, N. J.— Frenchtown, Locktown and Baptistown, New Jersey, have been connected by telephone. The line is being built to Sergeantsville, from which place it will extend to Flemington.

BURLINGTON, N. J.—The Standard Telephone Company, which has constructed a line thru a section of Bucks county, will extend its service to Burlington, New Jersey.

CAMDEN, N. J.—The Interstate Telephone Company, which has bought up the franchises and plants of most of the independent companies in New Jersey, has filed a mortgage for $5,000,000 with Register of Deeds Cole, in Camden. The mortgage was given to the Trenton Trust & Safe Deposit Company to secure a $5,000,000 issue of bonds, and the latter, in turn, are secured by franchises and plants. A similar mortgage is said to have been filed in every county in the State.

CAMDEN, N. J.—The Keystone Electric & Manufacturing Company has been formed. Principal office, New Jersey Corporation Guarantee & Trust Company building, 419 Market street, Camden, New Jersey. Objects, general electric and manufacturing business; capital stock, $250,000. Incorporators, Albert Schweitzer, A. Hausold, Samuel Brown.

SOUTH AMBOY, N. J.—A telephone has been placed in the engine-room of the Raritan

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drawbridge, and the men on the draw are now in regular communication with the rest of the world. The telephone was installed so that it could be used in case of accident.

JERSEY CITY, N. J.—Allis-Chalmers Company, Jersey City, New Jersey. Capital stock, $50,000,000; capital in Illinois, $4,467,000.

NEBRASKA.

BRADY ISLAND, NEB. — The Maxwell & Brady Telephone Company, Brady Island, Nebraska. Capital stock, $2,000. Incorporators, W. H. Plummer, G. R. Swancott, W. S. Cowgill, J. H. Giffen, E. D. Murphy, C. H. Kuhns, Reed Dolan and R. C. Burke.

O'NEIL, NEB.—The Holt County Telephone Company, with headquarters at O'Neil, filed articles of incorporation. The capital stock is $10,000. The company will operate telephone lines in Holt and Boyd counties. The incorporators are Ed. T. Gallagher, S. J. Weeks, O. O. Synder, T. F. Birmingham, T. V. Golden.

PLATTSMOUTH, NEB.—A new independent telephone company has been incorporated, with a capital stock of $50,000, to be known as the Home Telephone Company, and will have its headquarters at Papillion. The incorporators are J. D. Clarke, Papillion; C. F. Calhoun and J. M. Elwell, Springfield. The work of constructing exchanges at Springfield, Papillion and Gretna will begin at once.

PAPILLION, NEB.—The Home Independent Telephone Company, of Sarpy county, has been formed at Papillion, Nebraska, to cover the county with toll lines and to establish exchanges in all the towns of size. The capitalization is $50,000.

SCRIBNER, NEB.—The Farmers' Telephone Company, of Scribner, will soon have its line in operation.

NEW YORK.

ALBANY, N. Y.—A certificate of reduction of the capital stock of the International Bell Telephone Company, limited, from $750,000 to $500,000, was filed today with the Secretary of State.

ALBANY, N. Y.—The Albany Home Telephone Company has begun work on the establishment of the telephone plant which it proposes to operate in this city.

ALBANY, N. Y.—The controlling interest of the Citizens' Standard Telephone Company, of Kingston, has passed to the American Construction & Trading Company, of Elyria, Ohio. The deal was consummated when a check for $50,000, the purchase price, was handed to the officers of the old company. It is purposed to improve the telephone system and to extend it. Many thousand dollars will be expended in this work.

BATAVIA, N. Y.— No work is being done in Batavia on the Home Telephone system, but some of the wire recently sent here is being shipped to Dunkirk for use at that place.

COHOES, N. Y.—The Cohoes-Waterford Home Telephone Company, Cohoes, New York, to operate in Albany and Saratoga counties. Capital stock, $200,000. Directors, S. B. Rawson, F. H. Sudro and I. H. Griswold, Elyria, Ohio.

CORNING, N. Y.—W. W. Nichols, superintendent of construction of the Corning Telephone Company, is constructing a telephone system at Watkins. The system will be connected with a line to Corning via Big Flats, Horseheads, Pine Valley, Millport and Montour Falls.

DUNKIRK, N. Y.—The Dunkirk & Fredonia Telephone System, of which the Dunkirk line has but recently been established, is to be improved at an expense of some $1,500. Arthur R. Maytum, of Fredonia, is treasurer and local manager.

GREENWICH, N. Y.—The Consolidated Electric Company, of Greenwich, Washington county. Capital stock increased from $50,000 to $75,000.

JOHNSTOWN, N. Y.—The Glen Telephone Company has completed its trunk line between this city and Amsterdam, and connection has been made with the Automatic Telephone Company in that city. The toll charge for five minutes' use of the wire is 15 cents. The Glen company has also completed its trunk line between Fonda and Amsterdam.

JAMESTOWN, N. Y.—The Home Telephone Company, of Jamestown, has secured 400 contracts out of 500 desired.

KINGSTON, N. Y.—The American Construction & Trading Company, of Ohio, has secured the controlling interests of the Citizens' Standard Construction Company, of Kingston. Consideration to the extent of $50,000 was made. The deal is in line with the construction of a new telephone system to compete with the Hudson River Company in this section of the State. Joseph A. Farrell, John M. Bailey, Ten Eyck T. Mosher and James H. Leake, of this city, were former officers in the company.

KINGSTON, N. Y.—The annual meeting of the Citizens' Standard Telephone Company, held here, resulted in the election of Jay E. Klock, Mortimer C. Drake, Charles A. Schultz, Kingston; Howard Hendrickson, Albany; S. B. Rawson, I. H. Griswold, T. M. Brush, Elyria, Ohio, as directors. The officers elected were: Jay E. Klock, president; Mortimer C. Drake, vice-president, and Charles Reynolds, Jr., secretary and treasurer.

LOCKPORT, N Y.—The Rawson Electric Company, which is constructing the Home Telephone plant in Lockport, New York, has commenced connecting up the telephones, and already ten 'phones are in working order. The middle of this month will see the exchange in full working order in that city.

MONTOUR FALLS, N. Y.—Watkins Telephone Company. To operate in Watkins and Montour Falls, Schuyler county. Capital stock, $25,000. Directors: Joel H. Fuller, K. F. Gill and Charles B. Stowe, of Cleveland, Ohio.

NEW YORK, N. Y.—C. W. Morse, who was president of the ice trust until its methods became a subject of legal inquiry, has offered to buy the entire stock of the Telephone, Telegraph & Cable Company of America for

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an amount approximating $2,000,000. The directors have addressed a circular letter to the stockholders, recommending that the offer be accepted. Mr. Morse has agreed to pay to each stockholder exactly one-half of the amount paid in assessments.

NEW YORK, N. Y.—The Telephone Printing Company, of New York city. Capital stock, $40,000. Directors: R. A. Saalfield, E. H. Rosenblatt and F. A. Thomson, of New York city.

NIAGARA FALLS, N. Y.—The Niagara Falls Home Telephone Company, limited. Capital stock, $40,000. Incorporators: Dr. W. R. Campbell, M. B. Butler and others.

ROCHESTER, N. Y.—The Rochester Home Telephone Company is at Mendon Center constructing a thru line, direct from Rochester to Honeoye Falls. Connections will also be made with Mendon and Mendon Center.

SALAMANCA, N. Y.—The Wyoming & Cattaraugus Telephone Company, owned by Theodore Hayden, of Sandusky, and John Knight, of Arcade, has decided to capitalize. They will capitalize at $6,000.

SCHENECTADY, N. Y.—The Schenectady Home Telephone Company has been incorporated, with a capital stock of $250,000, to operate in Schenectady county. The company is one of the chain of independent telephone companies recently incorporated to operate in the State. The directors are: Samuel B. Rawson, T. M. Bush, I. H. Griswold, J. A. Dake, F. H. Sudro, A. E. Lord and E. M. Brush, Elyria, Ohio, and Howard Henderson, Albany.

WEST WINFIELD, N. Y.—F. C. Wilcox has obtained from the trustees a franchise to operate a telephone line, and expects to soon have it in operation. He already has many subscribers promised. The line will connect with the many rural lines that now center in his store, and will thus be in direct communication with a large surrounding territory. Mr. Wilcox expects to be able to render the service for about $10 a year.

OKLAHOMA TERRITORY.

HOBART, OKLA.—A territorial charter was issued to the Kiowa Telephone Company, of Hobart, Oklahoma Territory. The capital stock is fixed at $5,000. The directors are: J. R. Eddy, Eldon, Iowa; W. D. Davis, Pulaski, Iowa, and J. P. Evans, Hobart, Oklahoma Territory.

LAWTON, OKLA.—The Red River Telephone Company, with headquarters at Lawton, was chartered. The incorporators are: Jacob C. Roberts, W. J. Steel and J. Y. Callahan, of Kingfisher. The capital stock is $50,000. The officers of the company are: J. A. Overstreet, president; J. Y. Callahan, secretary; George Newer, treasurer; W. J. Steel, general manager.

OHIO.

AKRON, OHIO.—The Akron People's Telephone Company is issuing a new directory, including Barberton and Cuyahoga Falls. The company has 2,400 telephones.

BOWLING GREEN, OHIO.—The stockholders of the Bowling Green Telephone Company held a meeting and took steps to reincorporate the company, with a capital stock of $200,000. The name of the company will be changed to the Wood County Telephone Company. W. R. Barkdull was promoted from the position of manager of the local exchange to contracting agent. The company proposes extending its lines at an expense of $60,000 to include all the towns and villages in the county.

BELLEVUE, OHIO.—The Huron County Telephone Company and the New Washington Telephone Company, of Bellevue, Ohio, have consolidated under the name of the Huron County Telephone Company.

CLYDE, OHIO.—The Clyde Telephone Company, of Clyde, Ohio, has filed notice with the Secretary of State of an increase of capital stock from $10,000 to $40,000.

CINCINNATI, OHIO.—Philip Fitzsimmons, by Probate Court declaration, has announced that he has conveyed to the Fitzsimmons Telephone Manufacturing Company all his rights to use the streets and alleys of the city for telephone purposes.

CARROLLTON, OHIO.—The Carrollton Telephone Company has been organized with a view of giving a county service at a minimum cost of $8 for a residence and $20 for an office 'phone. The company comprises William J. Hays, J. R. Williams, L. S. Hall, O. P. McCully, J. C. Butler, W. S. Hoopes and Sam Stockton. They have applied for papers of incorporation with a capital stock of $10,000. It is said the Stark county company does not intend to cover Carroll county.

CANTON, OHIO.—The Star County Telephone Company, of this city, has increased its capital stock from $100,000 to $500,000.

CLEVELAND, OHIO.—After a hard fight, extending over two years, the Home Telephone Company, of Cleveland, secured a franchise to operate in this city. It is claimed a plant will be put in to cost $200,000.

CEDARVILLE, OHIO.—The Springfield city council met and granted a franchise to the Home Telephone Company, an independent company that will work in conjunction with other independent companies.

CELINA, OHIO.—The Celina Telephone Company has had a remarkable growth during the past year, and has increased its subscription list nearly one hundred per cent. Over two hundred lines are in operation, and the company will be obliged to install a switchboard having a larger capacity. H. H. Miller is secretary of the company.

COLUMBUS, OHIO.—The Huron County Telephone Company and the New Washington Telephone Company were combined into one company under the first name, and $60,000 capital stock. C. R. Callaghan is president and Frank A. Knopp secretary.

DAYTON, OHIO.—The Dayton Home Telephone Company has organized as follows: Directors: S. R. Harshman, John T. Barlow, H. C. Kiefober, F. G. Witheft, J. C. Reber, J. B. Hoge. Officers: John T. Barlow, president; H. D. Critchfield, vice-president;

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James C. Reber, secretary and treasurer; counsel, Albert Emanuel and H. D. Critchfield; Maxine Reber, consulting engineer. The capital stock of the company was increased from $100,000 to $750,000. The company will not only equip Dayton with a complete plant, but will build exchanges and farm lines thruout Montgomery county. The plant will be of the most modern type, with copper metallic circuits and underground wires in the business district.

DELAWARE, OHIO.—The Citizens' Telephone Company, of Delaware, has increased its capital stock from $40,000 to $60,000.

FORT RECOVERY, OHIO.—The Fort Recovery Telephone Company. Capital stock, $1,000.

FINDLAY, OHIO.—The Findlay Home Telephone Company and the city council are engaged in a controversy over the prices established by the former. The company's franchise provides that residence telephone shall cost not to exceed $12 per year, but the company is charging $18 a year. An effort is being made to revoke the franchise, and the matter will probably be carried into court.

FREMONT, OHIO.—The Fremont Home Telephone Company has declared a regular quarterly dividend of 1½ per cent. It has about six hundred telephones in operation, and the business is growing.

HUBBARD, OHIO.—The Youngstown Telephone Company has been granted a franchise to install an independent telephone exchange in this place.

HOPEDALE, OHIO.—The Home Telephone Company, of this place, has been organized by the following persons: W. H. Copeland, John B. Beadle, Asbury Cole, Martin Snyder, J. M. Copeland, J. G. Dixon, J. P. Ligett, Jacob Copeland, I. M. Irwin, J. R. Skelley, J. M. Kile, William Holmes, Winfield Holmes, W. V. Scott, J. B. Francis and N. B. Buckingham. They will build lines in Hopedale, Miller Station and Greenough, with a farmers' system thruout the community.

JACKSON, OHIO.—The Home Telephone Company is rapidly wiring the city. The cables are all up, and the connecting wires will be strung at once. The Home Company will start off with about six hundred subscribers.

KENTON, OHIO.—The Kenton Telephone Company, which was formed in 1898, has a dropboard of 500 capacity and 450 subscribers. Farm lines are projected. The American Electric Telephone Company's system is used.

MANTUA, OHIO.—The Mutual Home Telephone Company, of Mantua, Ohio, has been incorporated for the purpose of constructing a plant in that place. The capital stock is placed at $10,000.

MCCONNELLSVILLE, OHIO.— Irwin & Scott have purchased the interest of Thomas Drake in the Drake Telephone Company, and the company will continue business under the name of the Home Telephone Company. Improvements will be made.

MARYSVILLE, OHIO.—The Maryville Telephone Company is owned by Mr. N. E. Liggett and has been in operation since April, 1895. It now has a 250-drop board and 200 subscribers, sixty miles of local circuit and seventy-five of pole line. Farmers' lines are projected.

MILLERSBURG, OHIO.—The Killbuck Telephone Company is making a second attempt to secure a local franchise, despite the fact the Millersburg, Wooster & Orrville Telephone Company, an independent company, is giving satisfactory service. It offers lower rates than the latter company, and it is claimed that it is attempting to secure a franchise which will be turned over to the Bell company, which has no local exchange.

MARION, OHIO.—The Marion County Telephone Company, Marion, has asked the Probate Court to grant a franchise for the erection of a system in that town. It is asserted that the city council has been negligent in the consideration of the ordinance introduced some months ago.

OAK HARBOR, OHIO.—The Ottawa County Telephone Company is installing a 250-drop switchboard at its branch exchange here.

PAINESVILLE, OHIO.—The Painesville Telephone Company, Painesville, has filed notice with the Secretary of State that the capital stock of the company has been increased from $20,000 to $75,000.

SYLVANIA, OHIO.—The Home Telephone Company's Sylvania, Ohio, branch has been incorporated as a separate company. It is styled the Sylvania-Lucas County Home Telephone Company, and is capitalized for $10,000. The incorporators are Frank W. Wachter, F. F. Graves, Henry W. Barfield, Bernard J. Wagner and Charles E. Sumner.

SPRINGFIELD, OHIO.—The Home Telephone Company's plant at Springfield will cost about $200,000, and it is thought that it will be in operation with 1,500 telephones the first of the year.

TOLEDO, OHIO.—The Home Telephone Company, which has recently secured a franchise at Toledo, now has 4,000 subscribers. This is twice as many as the Bell Company has.

URBANA, OHIO.—The Urbana Telephone Company has decided to install new cable at a cost of $10,000. The company has recently increased its subscriber list to 325, and the business demands the installation of much new equipment.

VIENNA, OHIO.—A new automatic switchboard has been installed by the Independent Telephone Company, of this place. A large force is at work installing telephones.

WAPAKONETA, OHIO.— The Wapakoneta Telephone Company has just completed the installation of a new and up-to-date telephone system, replacing the old, at a cost of over $15,000.

XENIA, OHIO.—The Citizens' Telephone Company, of this place, has secured a good list of subscribers and will install a branch exchange at Yellow Springs.

ZANESVILLE, OHIO.—The Woodsfield Telephone Company met a short time ago and effected an organization for its management by electing J. B. Rhodes, of Zanesville, presi-

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dent; L. E. Stegner, Lewisville, vice-president; J. S. Cawley, Woodsfield, secretary and treasurer. The board of directors is composed of the above-named gentlemen and E. A. Culbertson, of Coraopolis, Pennsylvania.

PENNSYLVANIA.

ALTOONA, PA.—The Cresson Telephone Company, of Altoona, Pennsylvania, has bought the stock and franchises of the Northern Cambria Telephone Company.

DAUPHIN, PA.—The Dauphin (Pa.) County Telephone Company expects to start work on its new line in Steelton shortly.

HUNTINGTON, PA.—A charter has been issued by the State department to the Juniata Union Telephone Company, of Huntington. The capital stock is $1.000.

JOHNSTOWN, PA.—The Johnstown Telephone Company is now operating an entirely new system—new underground cables, new telephones, new switchboards and new building. Nearly 1,400 telephones have been connected up.

MANSFIELD, PA.—Citizens' Mutual Telephone & Telegraph Company, Mansfield; capital stock, $1,000.

NEWTOWN, PA.—A. M. Worstall, who promoted the $5,000.000 Interstate Telephone Company at Trenton, has gone to Florida to take up options on a number of independent telephone systems between Jacksonville and Washington, D. C., for a new thru line. Options are held on almost all of the lines along the proposed route, and Mr. Worstall expects to close the deal within a short time.

PENNSBURG, PA.—The Home Telephone Company, of this place, is planning to extend its lines to the near-by villages of Red Hill, East Greenville, Greenlane, Sumneytown and other rural villages.

READING PA.—The work of extending the Valley Telephone Lines to Reading has been completed to a point near the city limits. This is a part of the Consolidated Telephone Company system, which is to embrace many counties in eastern Pennsylvania.

SILVERDALE, PA.—The Borough Council has granted the Standard Telephone Company the privilege of erecting poles thru the town.

TOWANDA, PA.—Bradford County Telephone Company. Capital stock, $10,000.

VERONA, PA.—An ordinance giving permission to the American Telephone Company to run its lines thru Verona has been passed.

YORK CITY, PA.—Papers announcing a change in the name of the Schuylkill Valley Telephone Company to that of the Consolidated Telephone Companies of Pennsylvania have been filed with a notice of an increase of its capital stock from $500.000 to $4.000,000.

YORK, PA.—The Highland Telephone Company, which system embraces the Delta franchises, has declared a dividend of three per cent for the past six months.

NORTH DAKOTA.

DAVENPORT, N. D.—Local business men at Davenport contemplate installing a telephone exchange.

ELLENDALE, N. D.—The telephone system at Ellendale is proving satisfactory.

FESSENDEN, N. D.—C. E. Leslie has bought the telephone line running between Carrington, Harvey, Fessenden, North Dakota, and other towns along the Soo Line.

GRAND FORKS, N. D.—Work has commenced on building the underground telephone conduits, and under favorable conditions they may be completed in six months.

WALHALLA, N. D.—Langdon's local telephone line has been put in operation.

HANKINSON, N. D.—The Forman Telephone Company has begun work installing a local exchange for Hankinson, North Dakota.

HARVEY, N. D.—C. L. King, in charge of the exchange at Harvey, North Dakota, of the North Dakota Telephone & Electrical Company, refuses to turn the system over to C. E. Leslie, who bought the line from the receiver. King says that he built the exchange at Harvey and the line between Harcey and Fessenden with private funds, and when the North Dakota Telephone & Electrical Company was organized he did not turn the line over to that company. Suit will be instituted to settle the matter.

SOUTH DAKOTA.

ALEXANDRIA, S. D.—Work has been begun on the telephone system of Beulah township, in Hanson county. Nineteen farm houses will be connected, and will have connection with the telephone system of Alexandria.

BRIDGEWATER, S. D.—A company has been formed and materials ordered for the construction of a local exchange for Bridgewater, South Dakota.

BRIDGEWATER, S. D.—The Bridgewater Telephone Company, at Bridgewater, has been incorporated, with a capital stock of $2,500. The incorporators are: T. W. Dwight, G. S. Meredith, Jacob Tschetter, W. W. Noyes and W. C. Burroughs.

DEADWOOD, S. D.—The Harrison Telephone Company, of Deadwood, South Dakota, is making a number of extensions of its line in the Black Hills. The lines reach as far as Aladdin, Wyoming, and are being extended in several directions.

PARKSTON, S. D.—A company is being organized at Parkston, South Dakota, to put in a local telephone exchange, and from present indications it will no doubt meet with success.

TEXAS.

ALPINE, TEX.—Articles of incorporation have been filed by the Alpine-Terlingue Telephone Company, of Alpine, Brewster county, with a capital stock of $1,000.

AUSTIN, TEX.—The Austin City Telephone Company has amended its charter by increasing its capital stock to $200,000.

BROWNWOOD, TEX.—The Killeen, Brownwood & Western Telegraph & Telephone Company has been organized. Capital stock, $50,000. D. C. McDowell, manager.

EMORY, TEX.—Incorporated: Emory Telephone Company, capital stock, $1,000, by

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W. D. Peeples, A. H. Rodes, T. R. Potts and others.

EL PASO, TEX.—The Southern Independent Telephone & Telegraph Company, El Paso, Texas, to construct, maintain and operate a telephone and telegraph system in the city and county of El Paso. Capital stock, $200,000. Incorporators: Anney McElroy, Brett Lorain, Miller and J. B. Badger, of El Paso; W. V. Smith and B. S. Sprague, of Cuyahoga county, Ohio.

FERRIS, TEX.—Malloy & Co., of Ferris, and Truitt & Thompson, of Bristol, will construct telephone line from Ferris to Bristol, Texas.

ORANGE, TEX.—Orange Telephone Company, of Orange, Texas; capital stock, $40,000; incorporated by Melville D. Shaw, Walter D. Betters, C. N. Haskell, J. S. Brailey and others.

REED, TEX.—The Corsicana (Tex.) Telephone Company is said to be meeting with great success. There are at present 500 subscribers connected up, and subscriptions are coming in daily. Toll connections will soon be made with Reed, Eureka, Waco, San Antonio and other Texas points.

TENNESSEE.

ERIN, TENN.—The Hamilton County Telephone Company has just completed a telephone exchange at Stewart Station, Tennessee.

FRANKLIN, TENN.—A new telephone company is under consideration at Franklin, Tennessee. The company is said to be backed by local and Pennsylvania capital.

GALLATIN, TENN.—At Gallatin, the telephone company has passed a ruling that all users of telephones, unless they are subscribers, must pay for the privilege. As a result, a movement is said to be on foot to put in a new independent system.

KNOXVILLE, TENN.—The People's Telephone & Telegraph Company has completed the laying of its conduits on Commerce avenue and the connecting alleys. The experiment has proved so satisfactory that the company has decided to considerably extend its conduit system.

LEXINGTON, TENN.—The Jackson Telephone Company has been granted a franchise at Lexington, Tennessee. The company, it is said, proposes cheaper rates than those charged by the Cumberland Company.

MEMPHIS, TENN.—The Memphis Telephone Company, of Memphis, Tennessee, which represents the independent system, has won the first decision in the fight between the two rival companies. Judge Hammond has refused to grant the injunction asked for by the Cumberland Telephone Company, the representative of the Bell system. He ruled that the application for an injunction to restrain the new company from interfering with the manholes of the latter's conduit system was groundless, since the matter could be settled by an action for damages.

MEMPHIS, TENN.—The Memphis Telephone Company, it is stated, will erect a three-story exchange building, costing about $30,000. The first floor will be used for office purposes, the second for the use of employes, and the third for the switchboard, which will be equipped for 3,600 private wires.

MEIGS COUNTY, TENN.—The Tennessee River Telephone Company, of Meigs county, has amended its charter. The capital stock is increased from $3,000 to $10,000.

NASHVILLE, TENN.—The Luke T. Walker Telephone & Telegraph Company, of Davidson county, Nashville, Tennessee. Capital stock, $10,000. Incorporators: Luke T. Walker, J. W. Scott, E. T. Peck, W. M. Brandon and T. J. Brandon.

SPARTA, TENN.—The Gainsboro Telephone Company, with headquarters at this place, has just installed a multiple switchboard which will accommodate 1,500 drops and two operators.

VIRGINIA.

LEXINGTON, VA.—The Mutual Telephone system has been much damaged by storms.

RICHMOND, VA.—The new long-distance telephone line has been finished between Richmond and Petersburg, Virginia.

SCOTTSVILLE, VA.—Mr. J. W. Gulley, of Staunton, is getting rights of way for the Virginia Long-Distance Telephone Company, with a view to putting in a line from Staunton to this place, then on to Richmond, taking in the most important points between.

SPOTTSYLVANIA, VA.—The work of stringing the wire and putting in the telephones on the main line of the Spottsylvania Telephone Company from this point to Belmont and Lewiston has begun, all the poles now being in place.

VIRGILINA, VA.—The Virgilina Telephone Company has recently been organized at Virgilina, Virginia, for the purpose of constructing a telephone system connecting all the various mines of the district with Virginia.

WASHINGTON.

SEATTLE, WASH.—J. S. McGroaty was recently granted a franchise for a telephone exchange in Seattle, Washington, and deposited $3,500 as a guarantee that he would construct the system. He later sold his franchise to another company, which also wanted to install a system in Seattle, and then applied to the council for a return of his forfeit money. He held that the work started by his assigns was sufficient to cover the purpose of the deposit, and that he was entitled to a refund of the money. The council concluded to hold the money subject to forfeit.

WISCONSIN.

FOND DU LAC, WIS.—The Oakfield Telephone Company has eighty-five subscribers. It connects with the Little Wolf Company at Fond du Lac, the Lomira Company at Lehner's and Brownsville, and with Elgin, Rock River, Ladoga and Rosendale lines.

GALESBURG, WIS.—The W. P. Vietch Telephone line has been sold to the Arcadia Tel-

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ephone Company, of Arcadia, Wisconsin. The toll line covers seventy-five miles.

JANESVILLE, WIS.—The Independent Consolidated Telephone Company was incorporated by A. L. Hutchinson, Edwin I. Fairchild and Harry S. Hadfield, with $500,000 capital stock. A meeting of those interested was held subsequently to perfect plans for the completion of this company, which will operate thruout the State.

KILBOURN, WIS.—The long-distance telephone line between Portage and Kilbourn has passed into the hands of the Portage & Kilbourn Telephone Company, with T. B. Coon as president and Manning Van Alstine as secretary and treasurer. New poles are being set, and the line is being entirely rebuilt. The line will be used as a private line from Portage to Stroud's bank in Kilbourn, Stroud's bank having leased the line exclusively. Mr. Stroud bought the line a year ago from Baraboo parties, who bought it from F. Bell, who built the line. It has been a private line ever since, and is now to be repaired and maintained strictly private with Stroud's bank.

LA CROSSE, WIS.—George F. Miller has resigned as superintendent of the exchange of the People's Telephone Company at St. Charles, Minnesota, to take a position with the La Crosse Telephone Company, of La Crosse, Wisconsin.

LA CROSSE, WIS.—A plan is being matured whereby the La Crosse Telephone Company will extend its lines from this city to La Crescent, Minnesota, and Eagle Bluff. The reason for stringing the wires to the latter place is for the accommodation of the large number of summer resorters who are in the vicinity.

MARSHFIELD, WIS.—The first step toward the consolidation of all the independent companies in Wisconsin into one circuit with long-distance service has been taken. The Neillsville Company has purchased the line between Harshfield and Medford and will at once commence operations toward perfecting the line between the two places. The move will form complete connections between the cities of Marshfield, Wausau, Black River Falls and La Crosse, and will be made more complete in a few months.

MARSHFIELD, WIS.—Marshfield, Wisconsin, will soon have long-distance telephone connections. The differences between the local company and the Wisconsin Telephone Company have been adjusted, the latter company conceding all the points.

MILWAUKEE, WIS.—The Citizens Telephone Company will be organized, with a capital stock of $1,500,000. Among the incorporators are Judge Pereles, Michael Carpenter, Patrick Meehan, Joseph Bach and Philip Schmitt.

MILWAUKEE, WIS.—A. B. Ferdinand, president of the Northwestern Telephone & Electric Company, is planning to build a telephone line in this city, and will ask for a franchise.

MILWAUKEE, WIS.—The Independent Consolidated Telephone Company was incorporated by A. L. Hutchinson, Edwin I. Fairchild and Harry S. Hadfield, with $500,000 capital stock.

MONTELLO, WIS.—The telephone company has placed a new 100-drop switchboard at the central office in this village.

MARINETTE, WIS.—Applications for telephone franchises in Marinette and Menomonee have been made by former Governor Edward Scofield, of Oconto and A. L. Hutchinson, of Weyauwega, Wisconsin. They agree to have the systems in operation within a year, and will make them part of the independent telephone systems of Wisconsin.

OSHKOSH, WIS.—That law is expensive was again ascertained in the case of Krueger & Barnett *vs.* the Wisconsin Telephone Company. The former were awarded $25, but the case cost them about $2,000.

RICHMOND CENTER, WIS.—Farmers' Telephone Exchange, Richmond Center; capital stock, $5,000; incorporators, John Pier, John F. James.

RACINE, WIS.—Three linemen of the Wisconsin Telephone Company, at Racine, Wisconsin, were arrested on a charge of stealing 2,000 pounds of copper wire. One confessed and implicated three others. The wire was recovered.

RHINELANDER, WIS.—A stock company is being organized to build a telephone line from this city to Eagle River, Vilas county, taking in Robbins and Three Lakes. Enough stock to build the line has already been subscribed. The line will be extended to Tomahawk after it is on a firm financial basis.

SHEBOYGAN, WIS.—Alderman Teenies has prepared a series of rules and regulations for the granting of telephone franchises which will be adopted by the council. The maximum rate of a rental for business houses must not exceed $2.50 and for private residences $1.50 a month.

TWO RIVERS, WIS.—The Two Rivers Telephone Company has let a contract for the installation of an entire new system to take the place of the one now in use, which is no longer adequate to meet the demands. The new system will be so constructed that its patrons can have use of the long-distance telephone system.

WAUSAU, WIS.—It is reported that the Marathon County Telephone Company, of Wausau, Wisconsin, will sell its system to the new Wisconsin River Telephone Company.

WAUSAU, WIS.—The stockholders of the independent telephone companies of the Wisconsin Valley will meet to formulate plans for consolidating all the valley toll lines. Among the supporters of the project are: Judge Gaynor, of Grand Rapids; W. H. Bradley, of Tomahawk; Julius Thielman, of Merrill, and Senator A. L. Kreutzer, of Wausau.

WEST SALEM, WIS.—The Wisconsin Telephone Company is figuring on an exchange at West Salem, Wisconsin. The present service on the toll board is said to be very poor, and the patrons there are desirous of having something better.

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WAUKESHA, WIS.—The Independent Telephone Company has asked for a franchise in Waukesha, Wisconsin.

OTHER STATES.

DAWSON CITY, ALASKA.—Dawson City, in the famous Klondike region, has a telephone exchange of 300 connections operating. The subscription price is $25 a month.

RUSSELLVILLE, ALA.—The line of telephone from Tuscumbia to this place has been completed. Russellville is now connected with the world.

NEW BRITAIN, CONN.—A certificate of increase of the capital stock of the Farmington Valley Telephone Company, of New Britain, from $7,000 to $10,500, has been filed with the Secretary of State.

KISSIMMEE, FLA.—It is expected that a modern telephone plant will soon be constructed in Kissimmee, Florida. Senator C. A. Carson is to secure a charter from the city council, and will establish a local telephone exchange to be connected with the long-distance telephone.

YAZOO CITY, LA.—A new telephone line running from Yazoo City to Milestone, passing thru Eden, Blake and Thornton, has been completed and connection made with the Mutual Company.

FLORENCE, OREGON.—A contract has been awarded to H. H. Fish to build a telephone line from Florence to Acme. The line may soon be extended to Mapleton and Eugene.

RUTLAND, VT.—The La Salle & Marshall County Telephone Company. Capital stock increased from $50,000 to $100,000.

GLASGOW, SCOTLAND.—The municipal telephone system was inaugurated at Glasgow, Scotland, with all the latest improvements, wires all underground and 16,500 miles of wire.

TUNBRIDGE WELLS, ENGLAND.—The National Telephone Company, of Tunbridge Wells, England, has announced its intention of giving "an unlimited service for a penny a day" (2 cents) to its subscribers in that town.

WIRELESS TELEPHONY.

Sir William Preece's system of wireless telephony has been tried in Wales at the instance of the Postoffice, and with considerable success. So far as Sir William's experiments went, they were designed only to show the feasibility of telephoning over a short distance without the use of wires, and the Postoffice authorities were thoroly satisfied with the results. Since then Sir William has been "resting" from independent investigations of this nature, and he has not pursued his inquiry further. But the method and the means are at hand if the officials at St. Martin's-le-Grand ever desire to use them.

TRADE NOTES.

PALM, FECHTELER & CO. are showing handsome new marquetry effects for telephone boxes. They have just received some special designs which it would pay to inspect and add to the ornamentations and give a genteel finish to the telephone box. These designs were made at a great expense and are now a factor in the finish of a telephone box. They would be pleased to show their new designs, either at their offices or have their representative call.

THE Sterling Electric Company, of Lafayette, Indiana, is gaining ground fast with its Bell style of up-to-date equipment. Among recent orders are boards for the Farm & City Telephone Company, of Clinton, Ill., 300 numbers; Coon Bros., Rantoul, Ill., 200 numbers; Lackawanna Telephone Company, Olyphant, Pa., 100 numbers; an additional seventh section for the Johnson County Telephone Company, Iowa City, Iowa, and an additional eighth section for the Racine (Wis.) exchange.

PANIC AVERTED.

The last few days several rumors have had wide circulation, such as, "Devery Indicted," "The Steel Strike Is Over," "McKinley Is Dead," and several others. One very persistent rumor which gained ground rapidly and was heard with dismay among the hardware trade was to the effect that the supply of "The Green Book of Hardware Specialties," published by the Smith & Hemenway Company, New York city, had proven unequal to the demand and that no more were to be had.

Upon being interviewed, Mr. Smith, president of the company, evaded the question for a time but finally, in answer to a direct question, said, "While it is true that we are out of 'Green Books' at present, our friends need have no fear, for even now we are working on a new and larger edition which we will have ready in a short time, when we will supply them to all who wish them. In the meantime we will supply them with the pocket edition."

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WANTED,

WANT ADS.

Which will appear on this page under the heading "WANTS." They will be classified under the following heads:

HELP WANTED,

SITUATIONS WANTED,

STOCK WANTED,

CAPITAL WANTED,

EXCHANGES FOR SALE,

MATERIAL FOR SALE and

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Telephone Magazine

VOL. XVIII. CHICAGO, OCTOBER, 1901. NO. 121.

THE NEW MUNICIPAL EXCHANGE AT GLASGOW.

BY EDWARD MAULCLAY.

The advisability of the telephone system was first discussed by the corporation in February, 1893. At that time there was a special committee appointed to consider a report upon the treasury minute of May, 1892. Action on the recommendation resulted that the corporation, on the 3d day of August, applied to the Postmaster-General for a license to construct and maintain a telephone exchange within the city limits. One of the strongest points which urged the municipality to apply for a license for a telephone exchange was the inefficiency, together with the excessive cost, of the then existing telephone service, furnished by the National Telephone Company, and the need of providing the general community with telephone service which was both better and cheaper than that they were at that time obtaining. It was also deemed imperative to the corporation.

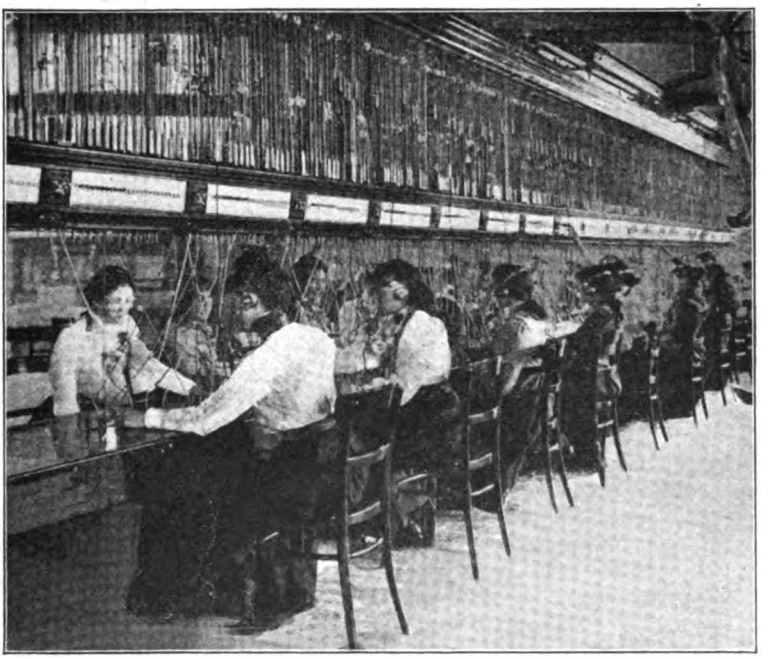

FIG. 1.

Correspondence with the Postmaster-General was carried on for two years, and at the end of that time the corporation gave evidence before a select committee of the House of Commons as to the result of granting a license to local authorities. But it was not until 1897

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that anything further was done, but late in 1897 the treasury determined to hold a local investigation at Glasgow. Sheriff Jameson, as royal commissioner, presided, and after hearing voluminous evidence, extending over eleven days, reported that on the whole they would advise that the grant of a license would be the best solution of the difficulty. But the Postmaster-General declined to grant a license, and on the 10th day of ———, 1898, a second select committee of the House of Commons was appointed to inquire whether telephones were of such general importance as to justify their supply being undertaken by the local authorities. The Glasgow corporation gave evidence before this committee, which reported that a general and effective competition exerted either by the postoffice or local authorities was necessary. On August 29, 1898, they renewed their application for license. This license covered the whole Glasgow area, as well as the city proper. After further correspondence the Postmaster-General on September 23, 1898, informed the corporation that he was now prepared to grant a license, provided they could obtain Parliamentary ruling to the effect that they could construct and maintain a telephone exchange.

The corporation accordingly presented a bill in Parliament, but before it reached the committee, Mr. Hanbury had introduced the telegraphic and telephonic communication bill upon which August 1 became a law under the title of the Telegraph Act. As soon as this act was passed, the corporation applied for license, on March 1, 1900, to construct a telephone exchange in Glasgow, and in four adjoining counties, namely, Lanark, Renfrew, Dumbarton and Sterling. This covers approximately 143 square miles. At the corporation's own request a license was made to expire on December 31, 1913. The Telephone Committee, acting under the presidency of ex-Bailie, who had long been identified with the movement to organize a telephone department, so as to commence operations at once, application to borrow $600,000 was made to the Secretary of State of Scotland. Permission was speedily granted. Mr. Alfred R. Bennett, M.E., E.E., who had taken a prominent part in the prolonged struggle for telephonic emancipation, was appointed general manager and engineer. After searching for a suitable location, the premises at Castle Chambers and Renfield street were leased for a central exchange and offices. Arrangements for sub-exchanges were made at Hillhear, Bridgeton, Springburn, Govan, Srathbungo, Maryhill and

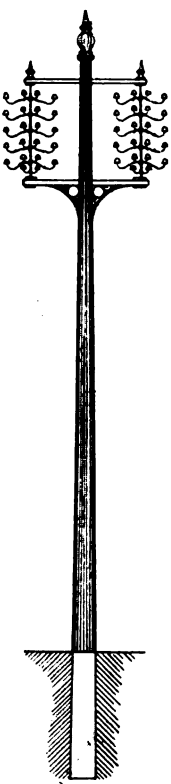

FIG. 2.

Kinning Park. The telephone committee then set about to arrange the rates for service. Two tariffs were adopted. The first is $26.50 per year for unlimited service over the whole extent of the area. The second rate is $17 per year and 1 cent for each call originating at each subscriber's station, for service over the whole area. Board room was provided for 10,500 subscribers. Half of this number of drops are installed. Fig. 1 shows the main operating-room.

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It will be seen in this board that it has the overhead type of jack.

It is the intention now of the managers to increase the size of the switchboard to a capacity of 20,000 lines; in fact, so brisk has the demand for telephones been, that in some places the cables have already been laid to accommodate this number of subscribers. The corporation wires are entirely laid underground in the center of the city. Further out, an aërial construction is used and where the lines go off to each individual subscriber. Of course where there are a great number of wires, even tho they be out of a thickly populated district, underground construction is used. All the poles used in aërial work are of

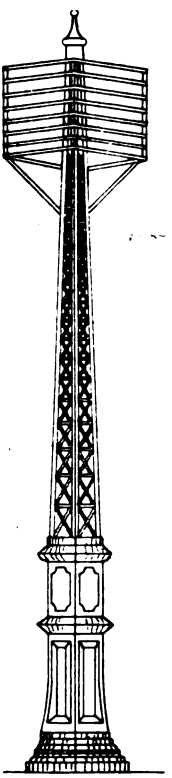

FIG. 3.

the ornamental type like those shown in Figs. 2, 3 and 4. The mains extend from the central exchange on Reinfield street to Whiteinch, Kelvin Side, Maryhill, Springburn, Parkhead, Hutchinson Town, Cross Hill, Scrathbungo and Kinning Park. The work of construction was commenced early in July in 1900, and has been carried on without any interruption. Fifty-two miles of trenching, with eighty-four manholes, have been excavated. In the streets have been laid seventy-seven miles of

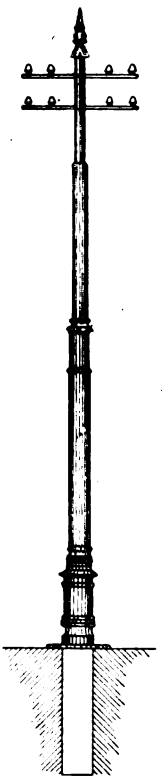

FIG. 4.

3-inch iron pipe and forty-one miles of cable. The method of underground construction has been to lay in the earth galvanized iron 3-inch pipe. Into this the lead cable has been drawn. The method of construction may be seen in Fig. 5. Operating service began on the central switchboard in March, 1901; since then, exchanges have been opened at Hill Head and Bridgeton. The number of subscribers actually connected is 1,450. Intercommunication with the Government trunk lines commenced on June 2, 1900, the corporation system on that day being placed in communication with all other exchange systems in Scotland.

One of the most novel features of

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this system is the telephone system installed for the municipal street railway in Glasgow. A description of this system is as follows: By means of these independent lines it will be possible to establish communication between any railway official from the street pillars, also connection with the section boxes, sub-stations, depots, powerhouses, head offices and residences. A 100-line switchboard at head office, with lines to the Pinkston power station, five sub-stations, fourteen depots and all the official residences of the staff, numbering about thirty-five stations. The board is of the General Electric Company's standard double-line pattern. A 100-line carbon lighting and heavy current arrester and distribution board is provided, in connection with the switchboard. There are about forty telephone street posts of the G. E. C. standard pattern K 1000, as shown in Fig. 6. These posts contain a Hunningscone-Deckert microphone double-pole Bell receiver, magneto call apparatus similar to the K 69 instruments and two dry cells. The posts are fitted with lock-up door, a key being carried by each official and tramcar conductor.

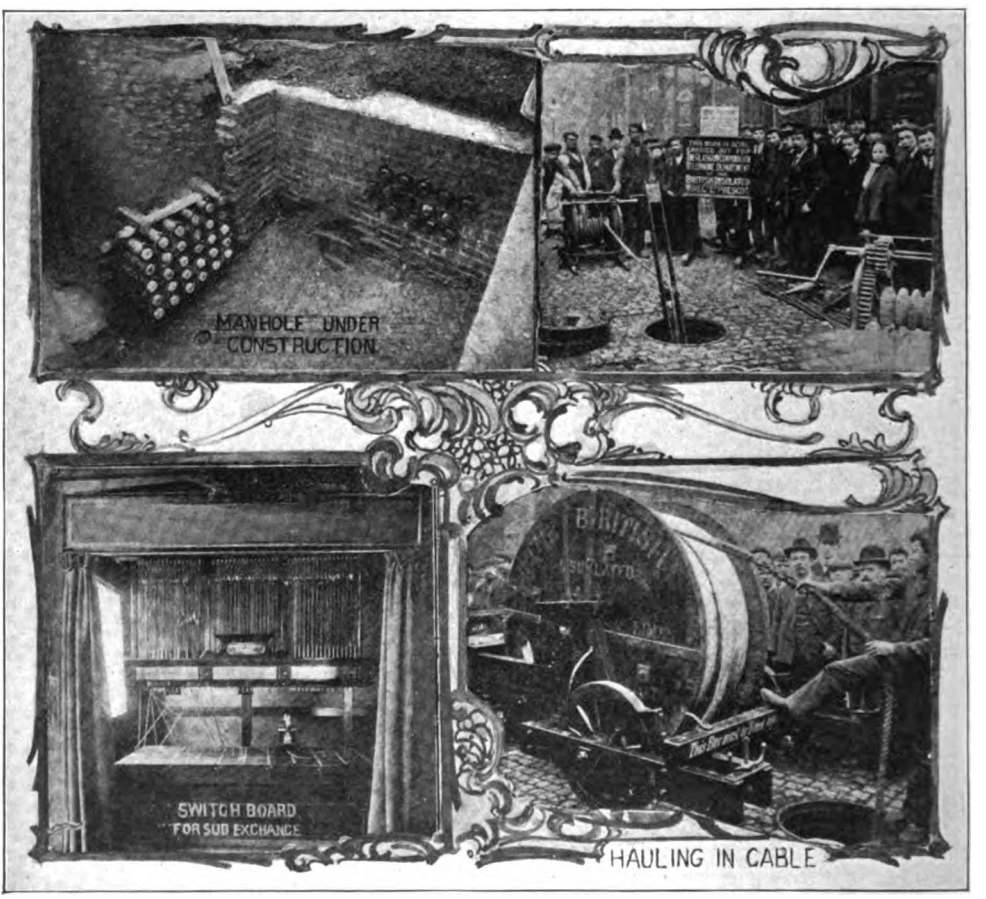

FIG. 5.

A 12-line switchboard at Pinkston power station, of similar type to that at head office, with lines to the five sub-stations and chief official residences. The instruments on this system are also of the K 69 type.

Every section pillar, of which there are one hundred and forty-two, is fitted

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with a G. E. C. patent traction telephone plug box, as shown in Fig. 7. These all radiate to the nearest sub-station,

FIG. 6.

where they call up the special terminal telephone. The telephone in the sub-station rings directly the four-pronged plug of the collapsible telephone is inserted and continues to ring until the receiver is lifted off the hook, when speaking can take place.

Every precaution has been taken to insure rapid communication, to insure prompt attention and repairs in case of accident or breakdown. In the event of such an occurrence the conductor or inspector unlocks the nearest street telephone post and reports the matter to head office, whence instructions are sent to Pinkston or to the nearest depot or sub-station, as may be necessary. The foreman of the emergency gang of workmen thus put in action is provided with a pocket telephone which he uses from the nearest section pillar to maintain communication with headquarters.

This street car system in connection with the telephone exchange is some-

FIG. 7.

thing new, and certainly can be classed as an advancement in telephone exchange systems. In Fig. 5 the method of hauling in cable is shown. In one of the photographs is shown a switchboard of a sub-exchange. These sub-exchange boards are of the latest patent and are up to date and compare to anything used in modern practice today. The number of orders on the books on August 23, 1901, was 5,382. The work of trenching, laying underground pipes, and supply laying and joining cables has been carried out by the British Insulated Wire Company, Limited; the switchboards were manufactured and erected by the Telegraph Manufacturing Company, Limited; the instruments by the Ericsson Telephone Company and the General Electric Company, Limited.

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WIRELESSNESS.

BY EDWARD J. WAKEMAN.

(*Continued.*)

For the second time in an international yacht race the Marconi system of wireless telegraphy scored an unqualified success. The first practical work ever done by this method of electrical transmission was when the Columbia and Shamrock I. raced two years ago. The improvements in the system since that time made this test more satisfactory.

The dispatch boat of the New York *Herald,* which followed the racers over the course, sent out bulletins to the receiving station on shore every few moments, in this way distancing all competitors and bringing into their respective offices complete and accurate details of every move of the yachts within a few minutes after they were made.

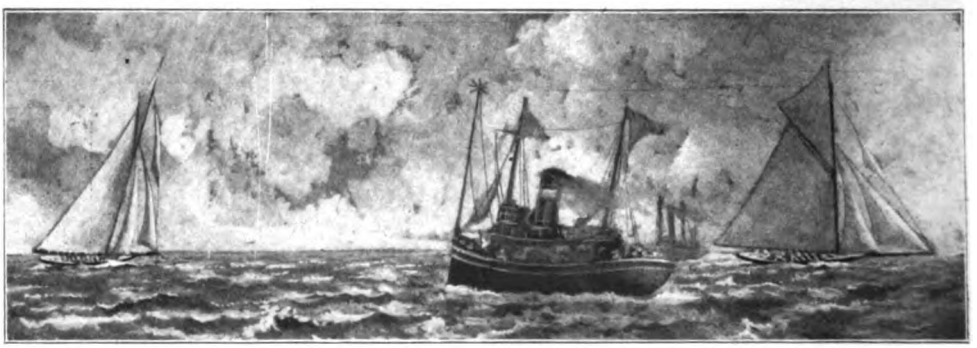

FIG. 1.

When it is understood that this service necessitated constant communication with a shore battery at times over twelve miles from the dispatch boat, the character of the test of the system can be realized. There was no error of any kind in transmission.

As far as the accuracy of the reports is concerned, it may be said that with all the mass of matter received hours later it was found that every word of the essential details sent to shore immediately after they transpired was correct and required no alteration.

The messages were sent from a boat which closely followed in the wake of the racers. The sending apparatus on board consisted of a staff which ran from the tugboat. This staff may be plainly seen in Fig. 1. This photograph also shows the yachts in the act of turning the outer mark, in the most exciting yacht race on record. The staff was arranged at the top with a basket-like arrangement of bare wire. Upon board the tug was both a complete sending and receiving outfit. The connection of the sending apparatus may be seen in Fig. 2. Coherer which was used at the receiving end was of a new type. The method of breaking cohesion being entirely new; that is, instead of rapping against the coherer, this coherer was mounted on an arm and given a rotary motion. This served to break the cohesion. Fig. 3 shows the connection at the receiving end. From the fact that this is the first time in the history of wireless telegraphy that a wireless message was set into print exactly as it was received, serves to indicate a complete triumph for Marconi.

AN AUTOMATIC TRANSFER.

Fred J. Cross, manager of the wireless telegraph company now operating the Marconi system in Hawaii, believes that he has made a distinct improvement in the Marconi system. He believes also that he has two other improvements which when perfected will amount to a complete transformation of the system.

The improvement already perfected

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consists of a means of transferring automatically the electric impulses received by the wireless instrument to an ordinary telegraph wire and thence conducting them to an ordinary Morse instrument. This improvement is in actual operation. The station and instruments of the company whence

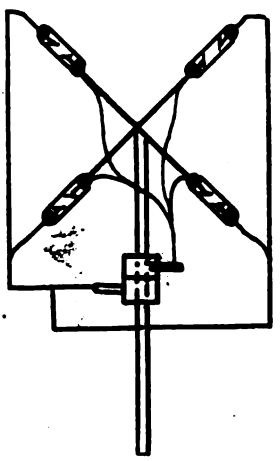

FIG. 2.

messages from this island to others are sent is located at Waialae, about four miles from the business part of the city and from the company's downtown office. Messages received at the office were sent by ordinary telegraph or telephone to the station and thence transmitted; and messages received there were likewise transmitted to the downtown office. By the new method messages received from other islands at the Waialae station are automatically relayed from the wireless instrument over an ordinary telegraph wire to the city office and received there on an ordinary Morse instrument. To make this improvement completely available and useful it is necessary to adapt it so that messages from the wire will be automatically received by the wireless instrument at one station and automatically transmitted to the next and so on till it reaches the station of destination.

GRAVITY THE SOLUTION.

Cross proposes to fit a large number of coherers into a cylinder, the axis of the coherers being parallel to that of the cylinder. When messages are being received the cylinder will revolve, bringing these coherers in succession into connection with the Marconi receiver. As the cylinder revolves each coherer will in turn reach the lowest point where the filings by gravity will fall apart, or decohere, making the coherer ready to receive a new impulse. By this method the wearing effect of the hammer will be avoided and the filings will not so speedily wear smooth and round.

KENTUCKY ACTIVITY.

The activity of the Independent telephone companies in the State of Kentucky is shown by the following figures: There are today over 20,000 telephones in use; five years ago there were 500. The capital invested is $3,000,000. There are eighty-three Independent telephone exchanges in the State, and eight are in course of construction.

IRON CEMENT.

To 98 parts of iron filings put 2 parts of sal ammoniac, using as much soft water as will make the ingredient into a paste of the consistency required for use. This cement is particularly useful to fill cracks, blowholes, etc., in castings. It is really a " rust " cement, and its particular quality depends on the fact that it swells during setting, thus filling the space completely.

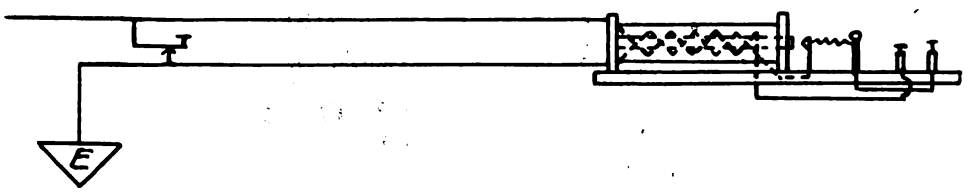

FIG. 3.

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THE NEW TELEPHONE EXCHANGE AT MUNICH.*

(*Continued from page 182.*)

Simultaneously with the new work in Exchange II, one of the boards of the old trunk office was transformed into a trunk junction board for Local Exchange I, and a new trunk exchange was installed, which in point of completeness in its technical details leaves little to be desired. The new trunk installation is intended to receive a maximum of 100 urban junction wires. At present it is fitted up for forty-eight, and may be easily extended at any time. Lamp signaling is used thruout, and all the parts of the apparatus are of exceptionally solid construction.

The transfer board (Fig. 8) has two positions, and is provisionally fitted with fifty call lamps, fifty lamps for indicat-

* Abstract from the *Elektrotechnische Zeitschrift*.

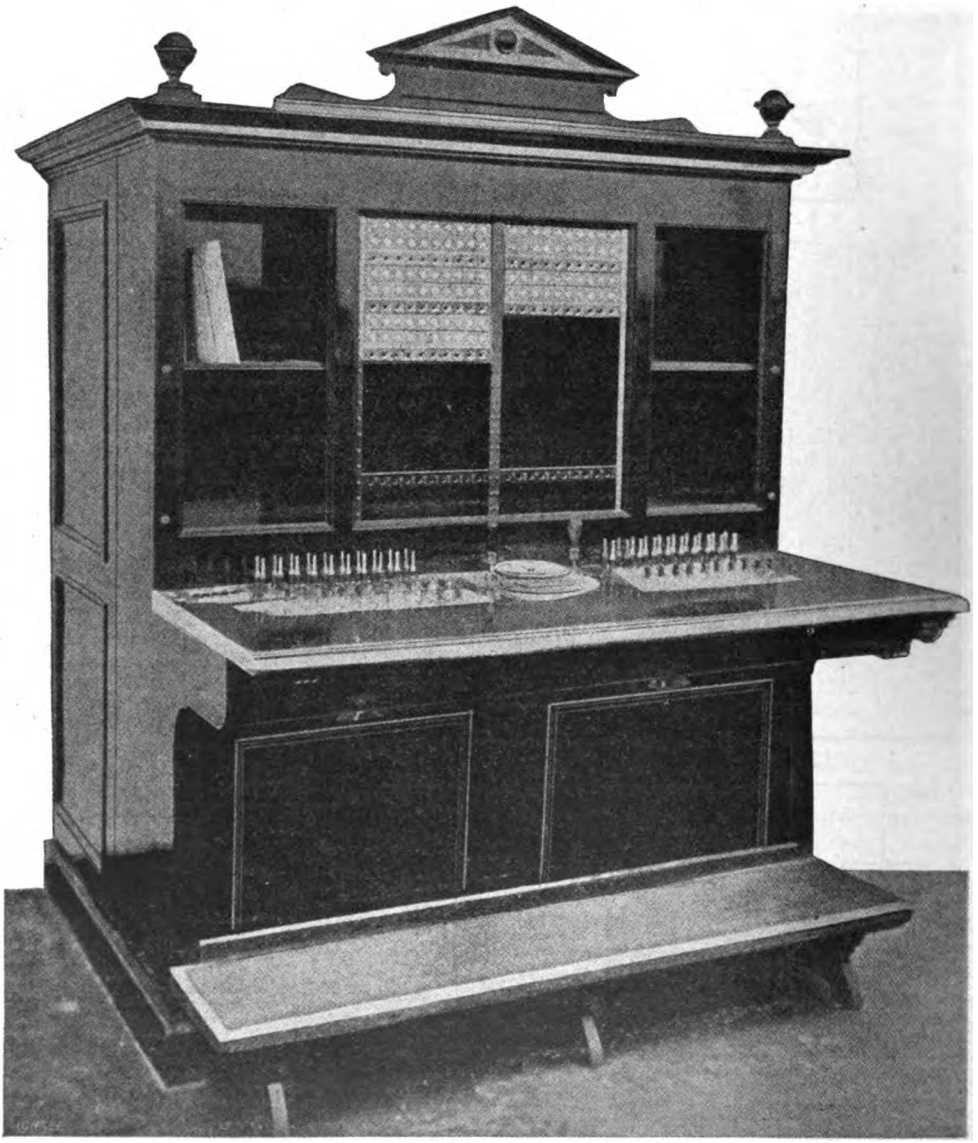

FIG 8

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ing whether trunks are engaged ("engaged lamps"), fifty answering jacks and twenty junction jacks. On the keyboard of each position ten cords, ten clearing lamps, one control and one call lamp, five speaking keys with five engaged lamps, and twenty-one combination keys are provided. The calculagraph in the center for recording the time occupied by conversations is common to both positions.

The incoming trunk lines all pass thru the jacks of the transfer board before they are distributed to the various trunk tables. The transfer board has a double

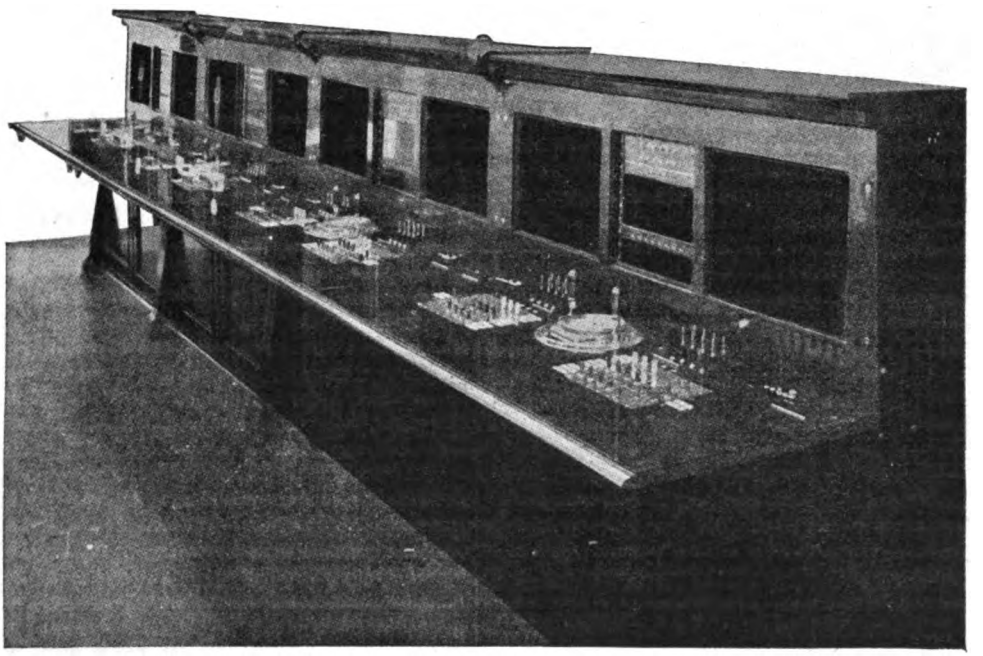

FIG. 9.

function; in the first place, it serves to connect the trunk lines with each other; and, secondly, when there is but little traffic, the whole of the trunk connections can be effected at this board by one operator. By this arrangement the multiplying of the trunk lines to all the trunk tables is dispensed with. The trunk line tables (Fig. 9), which also have two operators' positions each, are similarly fitted.

The record tables, at which the demands for trunk connections are received and noted, have three operators' positions each. At one table demands for trunk connections are received from Exchange I and at the other from Exchange II. They are connected to jacks on the subscribers' board, and a system of automatic signaling indicates to the operator at that board when the subscribers' demand has been noted and his line can be disconnected. On the keyboard of each operator's position, at the record tables there are thirty signal lamps and thirty keys; over these is a control lamp which, in this case, has special importance. Two cords, with plugs, and two combination keys per operator's position, and ten jacks with out-going service lines at the central position of each table complete the equipment. If Munich be called up by a distant office — Berlin, for example — (Fig. 10) the calling current, after passing thru the jack at the transfer-board goes to the particular trunk table to which the Berlin line has been allocated, and then passes thru the jack and key 3 to the main coil of the line relay. The armature of the latter is attracted and the line lamp at the Berlin position lights up. Simultaneously a circuit thru the

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control relay and the retaining coil of the line relay is closed. The control lamp at the Berlin position consequently also glows, and the armature of the line relay is prevented from falling back. The operator takes an answering plug, inserts it in the Berlin jack, pushes back the combination key to the speaking position, and is then connected with Berlin. By the insertion of the plug in the jack the contacts l and r are opened and contact e^2 is closed. The main coil of Berlin line is engaged. Circuit: Positive pole e, e_1, contacts e_3, e_2, the two engaged lamps in parallel, negative pole. The Berlin line is, therefore, cut off from the operators at the transfer board.

Berlin may desire to speak either to a subscriber of a third local exchange — Augsburg, for example — or to a subscriber of the Munich system. In the first case the operator at the Berlin position can herself directly make the desired connection if the Augsburg line

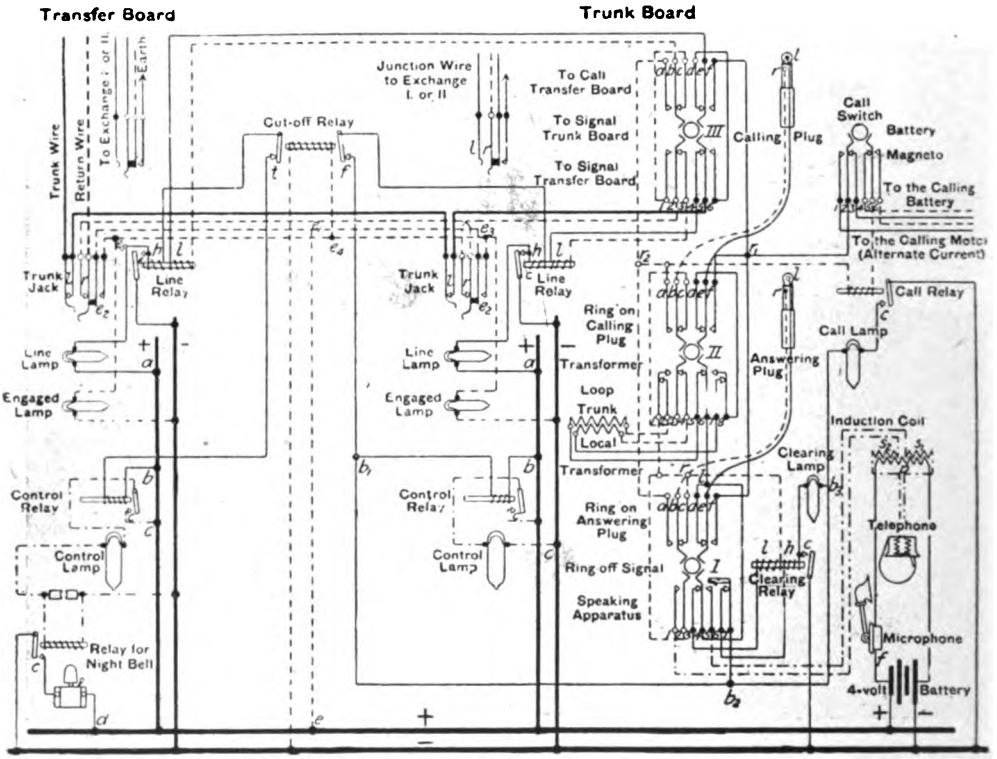

FIG. 10.

the line relay is thereby cut out of the trunk line and the cut-off relay is actuated. Circuit: Positive pole e, e_1, contacts e_2, e_3, e_4, coil of cut-off relay, negative pole. The cut-off relay attracts its armature, breaks the contact at f, and so interrupts the circuit of the retaining coil. On the insertion of the plug in the jack, the Berlin call lamp and the control lamp, therefore, cease to glow; on the other hand, a lamp lights up at the Berlin position and at the transfer board, showing that the is connected to the same trunk table and is disengaged. If this is not the case she passes on the demand to the transfer board by withdrawing her plug from the trunk jack and pulling forward key 3 for a moment, thereby calling the transfer board. She thus causes the Berlin line lamp and the control lamp at the transfer board to light up. Circuit: Call battery, B, springs 3 and 2 of the call-switch, r', springs f and e of combination key 3, main coil of the line relay for the transfer board and back. The

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operator at the transfer board receives Berlin's demand and makes the connection with Augsburg.

If Berlin desires to speak to a subscriber of the Munich system, the operator at the Berlin position must make a connection with the trunk junction board of that local exchange to which the required subscriber is connected.

The communication between the trunk line office and the two exchanges is organized in a similar way to that between the two exchanges themselves, i. e., by means of speaking wires and junctions.

THE SLUG EVIL.

Powerless to combat the "slug" evil, the Chicago Telephone Company has adopted drastic measures to abate the nuisance. From this time on, patrons of the telephone company will be held responsible, it is said, for all "slugs" deposited in the slot machines.

Patrons will either have to make good the amount represented by the slugs or the machines will be removed from their places of business. This is the latest dictum issued by Treasurer Mosley, of the telephone company. Mr. Mosley says the rule will be strictly enforced. He declares that a number of telephones have already been taken out, and that more are to follow.

An official of the telephone company made the statement that last year the company was mulcted out of $110,000 thru iron, lead and brass slugs placed in the telephone machines in lieu of the silver 10-cent piece. There are over 3,000 slot machine telephones in the city and it is estimated that these will average a "slug" a day. Many of the machines show more "slugs" than "coin of the realm" at the end of the month.

Enormous quantities of these leaden pieces are being put on the market. The business is thoroly organized. Agents have regular routes in office buildings and wherever the slot telephone is used. These agents see to it that any one who may desire to defraud the telephone company is kept fully supplied.

A month ago the town was inundated with a special slug imported from California. It is a neat brass slug, the size of a 10-cent piece. It has two holes punctured in the center and much resembles a brass button. These slugs are arranged on cardboard and are sold for 30 cents a hundred. At the top of the card are these words:

"These are brass buttons. Under no circumstances must they be used for telephones or slot machines."

When the agent presents his buttons for sale, he "winks the other eye."

The telephone company was quickly notified of the presence of the California button, but the special officers in the employ of the corporation were unable to even make an arrest. The venders of these buttons are about the streets every day and boldly carry on their traffic.

The slug evil is likely, according to the assertion of a telephone official, to cause a reduction in the price of telephone service. The statutes of the United States define token money as anything to represent a 2, 3 or 5 cent piece. Token money does not apply to a 10-cent piece. Accordingly, the 5-cent slot telephones have so far been comparatively free from fraud. Any one putting slugs into a 5-cent telephone may be brought before the Federal Court, it is claimed, and punished severely. As a result the telephone company may, it is said, change all its 10-cent instruments to 5-cent instruments.

Owners of slot contrivances collect tons of inferior metal. The lot of the slot machine is not a happy one. Attempts are made to defraud it with pieces of tin, hairpins, wire, needles and pins and a variegated selection of iron, lead, brass and other metals which would equip a good-sized junk shop. The owners of peanut, match, gum, weight and other slot devices which are set in public places estimate a safe profit if two-thirds of the returns are United States money.

"We are unable to combat with this evil," said a telephone company official. "We have special policemen in our employ who try to protect us, but there are no laws or statutes which cover the 10-cent slot machine. Several efforts have been made to indict men for using these slugs, but so far the telephone company

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has not been able to secure a conviction. The slot machine is a new thing in the law. It will require special legislation to protect it. The telephone companies of the country have now got to the point where they must hold the subscriber responsible for what goes into the machine. It is placing another responsibility upon the subscriber, but it is the only way out of the dilemma."

Assistant State's Attorney Blair said: "I have made an exhaustive examination of the laws in connection with slot machines, and I find there is nothing in the statutes of the State of Illinois covering the users, salesmen or manufacturers of slugs. The gas and electric light companies found themselves in the same condition at the beginning. They were compelled to secure special legislation to protect their rights. The law did not recognize gas or electric light as property. It was made an offense to tamper with gas meters or electric light wires with the intention of defrauding the company. It will be necessary for owners of slot machines to secure special legislation. If it could be proved that certain men had entered into a conspiracy to manufacture slugs for the purpose of defrauding the telephone company, then these men could be punished for conspiracy to defraud. Telephone service is not recognized as property. There is no intent under the law, therefore, to secure property or money under false pretenses when a slug is used."

A NEW ILLINOIS TELEPHONE COMPANY.

The new company proposes to establish a long-distance single-line system and give an annual rate of $40 a year for business purposes and $24 a year for residences. In addition to its city service, the new company proposes to establish a rural service, and place a 'phone in every farmhouse in Peoria county at a fascinatingly low rate. At the head of the new company is State Senator H. H. Evans, of Aurora, Illinois, while State Senator Case, of Chicago, and C. R. Conkling, of Joliet, are directors. They propose to come here and establish a system by which it will be possible to talk all over central Illinois at 5 cents per talk. It is a competitive combine, in which several systems are united, and when all are perfected it will be possible to talk from one end of the State to the other for a single nickel, or one will be able to talk all over the State for $1. This combine has a capital of $10,000,000, and it is buying up all the Independent telephone lines in the State. State Senator Case, the Chicago man in the concern, says:

"We are going to buy up all the Independent lines in the State and fight the Bell Company all along the line. Only the other day we purchased the Independent line at Oskaloosa, Iowa, for $180,000. For the lines in Kane county, Illinois, we paid $500,000.

"We have put in multiple switchboards with a capacity for 1,200 telephones at Joliet and 825 at Aurora. We are now putting in switchboards for 700 telephones at Sterling, and when Senator Evans gets the franchise for Peoria we will put in a new multiple board for 800 telephones here at a cost of $15,500. In Aurora and Kane county we will soon have twenty miles of underground wire. We do not find it necessary to utilize any of the Bell telephone patents, many of which have expired, anyway.

"We believe the era of cheap telephones has come to stay. We give 5-cent distance telephone instruments to business houses for $30 a year, and to farmers and city residences for from $15 to $18. At first our cut-rate was not met by the telephone monopoly, but now it is being met at every point. Still, we think there is enough money in the business to allow two rival concerns to pay handsome dividends."

NEW TELEPHONE STOCK.

Certificates of the $1,000,000 of new stock of the Chicago Telephone Company will be issued October 9, and five per cent interest is allowed on all prepayments. This last issue will make $2,000,000 put out this year, bringing the total capital outstanding up to $9,000,000.

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TALKS AND CROSS-TALKS.

BY THE INSPECTOR.

HINTS TO CORRESPONDENTS.

Write on one side of the paper only, and make sketch or diagram, when necessary. Endeavor to give all the facts bearing on the case, so as to enable the editor to answer intelligently.

Name and address must accompany each letter, not for publication, but for the information of the publisher.

147. GENTLEMEN,—We have two 'phones on one line. Fig. 1 is a diagram of the same. 'Phone No. 2 works fine, but 'phone No. 1 rings feebly, also talks, and receiving part is weak. We have tried the same 'phone at Station 2 as at Station 1, but it works just as poorly. Could the Inspector tell us where the mistake is, or show us a better method?

A READER.

You do not state in your letter how your telephone at Station 2 is connected, but from your drawing it appears to be bridged. If this is the case, your trouble is easily remedied. You have but to connect No. 1, as shown in Fig. 2. This will bridge it across the line, and then all your 'phones will work alike. If this is not the case, I would like to hear from you again, but undoubtedly this will remedy your trouble.

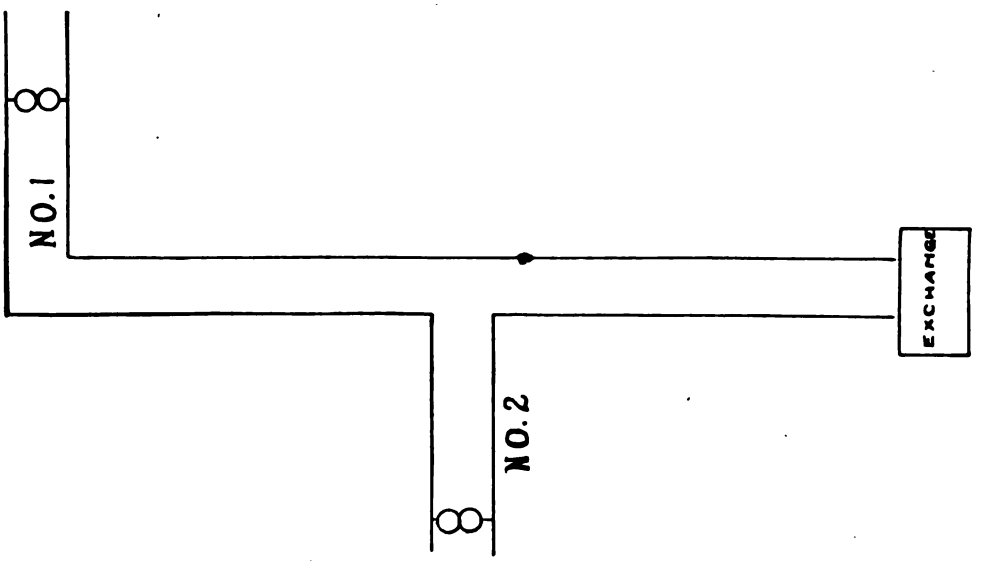

FIG. 1.

148. DEAR SIR,—What is the difference between rubber-covered wire and weather-proof wire? Is not rubber-covered wire weather-proof? Will you kindly answer the above and oblige, A CONSTANT READER.

Rubber-covered wire is weather-proof, but weatherproof wire is not always rubber-covered. That is to say, weatherproof wire is covered with a rubber compound; this in turn is surrounded with a cotton or linen braid. There are several brands of wire on the market which are rubber-covered, with a braid on top of the rubber. These are weatherproof wires.

149. MR. INSPECTOR,—Will you kindly answer the following question: What, as a rule, is the maximum current strength that can be allowed to pass thru the ordinary carbon-clad microphones? J. V.

Granular transmitters vary according to their mechanical construction. The solid-back transmitter used by the Bell Company will work with as high as 12

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volts and 6 amperes. After the voltage, or amperage, has been increased, there is a frying or sizzling caused by the disintegration of the carbon, due to this high current. There are several Independent telephone concerns manufacturing transmitters that will work with as high as 15 volts and 6 amperes. A good transmitter will work with any voltage up to 50 volts, providing the amperage is low enough. The maximum amount of current should be about 2 amperes.

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150. GENTLEMEN,— I have a telephone line sixty miles long with five 1,600-ohm telephones bridged on with the ground, and I wish to use the line for both telephone and telegraph. What changes are necessary to make above practicable?

Please answer thru THE TELEPHONE MAGAZINE and oblige, Yours truly, S. G. H.

You do not state in your letter whether you want to telegraph to intermediate points along the line or not, but I assume that you wish to locate a telegraph instrument at each end of the line. What you will want will be a 1600-ohm relay and sounder at each end, together with the necessary keys. This may be connected as shown in Fig. 3. Of course, with the system I show, you could not obtain simultaneous telephony or telegraphy. To obtain this you would need more material than I have mentioned. In the August issue one of our readers was kind enough to show how this could be obtained. If you have not a copy of the August issue, write to me and I will send you a copy of the same.

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151. DEAR SIR,— I would like to get rid of the gravity batteries we have on our switchboard for supplying our switchboard transmitters. I would like to have storage batteries instead, but I do not want to put in a dynamo to charge them, as I would have to put in a motor to run the dynamo. This would be quite expensive. We have 110 volts alternating-current for lighting purposes, or 500 volts direct-current which is used in street-car service. Is there not some method by which I could charge a battery off this current? F. E. B.

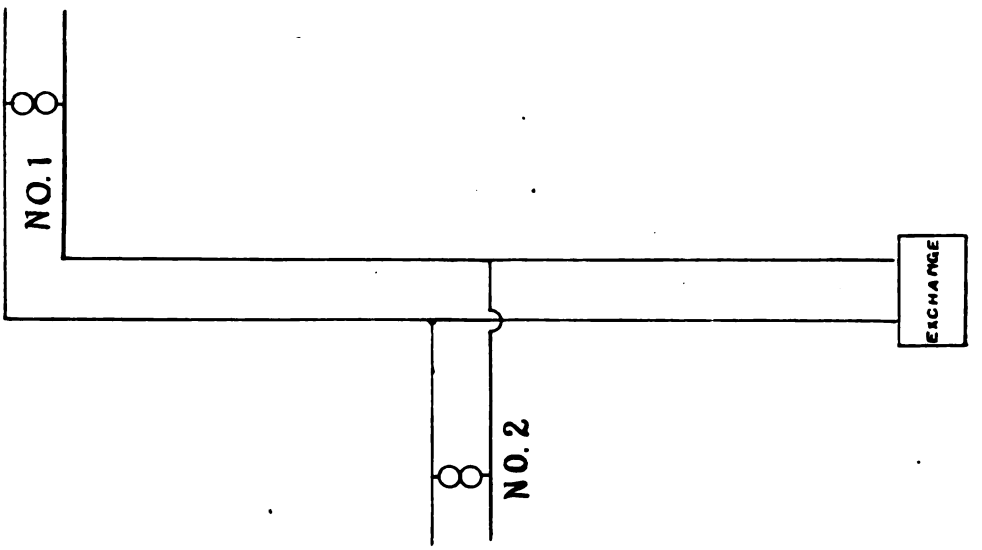

FIG. 2.

You could have two storage batteries and you could charge one while using the other. You could either make these cells yourself or buy them. You would then arrange a bank of lamps as shown in Fig. 4, making a series loop as is shown at A, and by connecting your storage battery at this loop, you could charge it. You could charge one while you were discharging the other. In case you desire to make your own cells, if you will address me, care of this department, I will show you how it can be done.

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152. DEAR SIR,—You will kindly pardon my ignorance in asking a question that may seem to you ridiculous.

Where is the benefit of using platinum contacts? I was always under the impression that silver was the best conductor. L. F. B.

You are quite correct in stating that silver is the best conductor. It is not for its conductivity that platinum is used, but from the fact that it does not corrode, oxygen having no effect upon it at any temperature. Another point in its favor is that it does not fuse at the point of contact like other metals, consequently it does not stick. These two features make it valuable as an aid in electrical work.

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153. DEAR SIR,—In a 50-line telephone exchange would you recommend a heavy-sized wire for the common return? We are using No. 14 galvanized wire. Would you recommend No. 12 to be used for a common return, or would you recommend a heavier size, and what are the benefits from using a heavier wire for a common return as compared with a wire the same size as your individual line wire?

Kindly answer this question and oblige,

N. R. S.

I would recommend No. 10 B and S, or larger, and in no case would I use smaller wire. The reason a heavier wire is recommended is because the common return must carry one-half the load of the other wire, and if ten parties are talking at the same time and you are using the same size common return as the other wire, your common return will be overloaded, and your line will be out of balance, which will result in induction and cross-talk, resulting in a very noisy exchange.

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154. GENTLEMEN,—We are making a strong effort to organize a county telephone company in this county, Canall county, with a *free* toll system, all over this county to subscribers paying $1 to $2 per month. Will this pay? Is the plan satisfactory in other States? Respectfully, W. S. W.

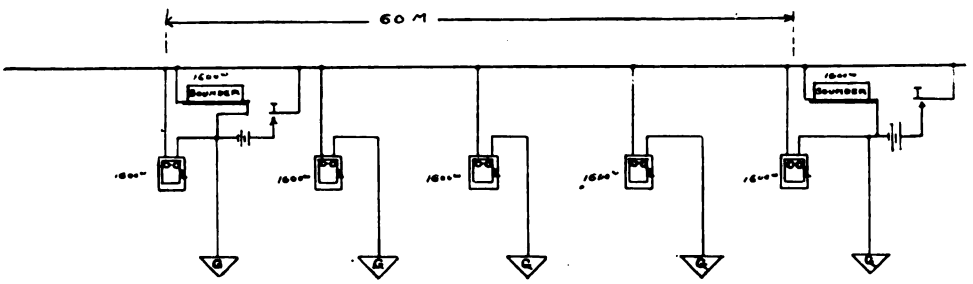

FIG. 3.

The $2 rate will allow you to run and do quite well. A dollar is hardly a large enough amount of money for the service you intend giving, but exchanges have prospered at the $2 rate, covering a greater area of territory than yours.

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155. DEAR SIR,—Where the galvanized iron wire of the line makes connection with the office wire which we use for inside wiring, would you recommend that these two be soldered together, or is just a good, tight splice sufficient? L. M. W.

By all means solder your connections, in fact, I would recommend the use of a connection sleeve. This makes a good tight joint, and after it is soldered it is the splice that can be relied upon as to good electrical connection.

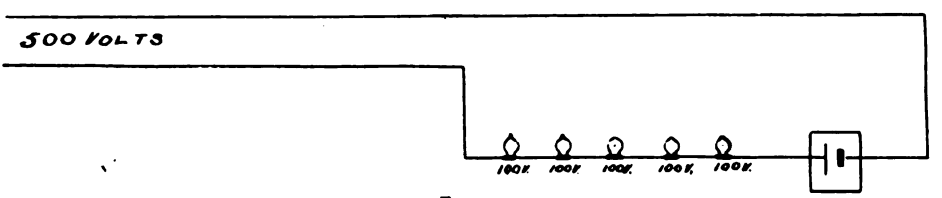

FIG. 4.

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156. DEAR SIR,—We have a number of old ringers, the coils test up all right, and no matter how we try to adjust them they will not ring properly. They ring all right across themselves, but will not ring from our power generator. Will you kindly tell us what is the matter with them? D. E. T.

The field pieces of these ringers have lost their magnetism, and the reason they ring from a hand generator is that the frequency is low, and each pulsation has a chance to act upon the armature; whereas with your power generator the frequency is high, and the alternations so rapid that each pulsation does not change the poles for a long enough period to attract the armature without the fields possessing enough permanent magnetism. You may magnetize these field-pieces by removing the coils and placing the fields against a motor, and pulling them away and replacing them again. This will magnetize them and these ringers will then work in a satisfactory manner.

INDEPENDENTS INCREASE THEIR TOLL MILEAGE.

Frankfort, Indiana, September 25.—Twenty coöperative telephone companies, representing altogether nearly 10,000 'phones, have been consolidated under the name of the People's Telephone Company. A six-mile trunk line will be constructed to this city, where connection will be made with the wires of the New Long Distance Company, of Indianapolis. This consolidation puts the Independent companies in a commanding position.

AFFIDAVIT LEGAL OVER TELEPHONE.

Judge Burke, of Baltimore, Maryland, rendered a decision yesterday in the case of Benjamin W. Cross against the Manor Lumber Company and Charles E. Cockran, dismissing the petition to rescind the order appointing Osborne I. Yellott receiver for the company. The principal point involved in the petition was that the affidavit of Mr. Cross to the bill of complaint was secured from him while he was in Cincinnati by means of a long-distance telephone. Judge Burke, in his decision, says:

"Upon the allegation of insolvency and the other facts stated in the bill of complaint, I am of the opinion that the court had jurisdiction to appoint a receiver for the defendant company. The motion to rescind the order appointing the receiver must, therefore, rest upon the contention that there was no legal affidavit to the facts stated in the bill. Under the facts and circumstances of the case, as shown by the proceedings, I do not think it is my duty to rescind the appointment of a receiver."

DEVELOPMENT OF THE TELEPHONE.

BOSTON, MASS.—In the point of telephone development, San Francisco towers above the rest of the cities, with a telephone for every sixteen of its population. Estimating five persons to a family, it may be said that in this far Western city every third family has a telephone. Boston takes second place in this development, with a telephone for every twenty-four inhabitants, or one telephone for every five families.

Philadelphia shows the largest relative gain in the number of telephones in use, with an increase of sixty-three per cent over the year ended December 31, 1899, Louisville coming next in the order, with a gain of forty-three per cent.

The telephone situation in some of the larger cities in the United States is as follows:

City.	Telephones Dec. 31, 1899.	Dec. 31, 1900.	Per ct. of	Pop'la'n census 1900.	Pop'la'n per telephone.
New York (all boroughs) ..	53,128	70,870	33	3,437,202	48
Buffalo	5,107	6,639	30	352,219	53
San Francisco.	16,817	21,324	27	342,782	16
Boston	19,905	23,780	19	560,892	24
Minneapolis ..	6,210	8,038	29	202,718	25
Cleveland	13,158	14,570	11	381,768	26
Detroit	7,434	10,190	37	285,704	28
Milwaukee	6,893	8,492	23	285,315	33
Manh't'n(N.Y.)	39,770	53,275	33	1,850,093	35
Pittsburg	7,409	9,129	24	321,616	35
Cincinnati	7,161	9,142	28	325,902	35
Man. & Bronx (Old N. Y.)	40,437	54,647	35	2,050,600	37
Louisville	3,539	5,049	43	204,731	41
Newark	3,701	4,434	19	246,070	55
Washington ..	3,278	4,650	42	278,718	60
Chicago	21,237	27,734	31	1,698,575	61
New Orleans..	3,274	4,415	35	287,104	65
St. Louis.....	6,369	7,512	18	575,238	76
Baltimore	5,340	6,250	17	508,957	81
Brooklyn	10,379	13,366	28	1,166,582	87
Philadelphia ..	8,263	13,451	63	1,293,697	96
Jersey City....	1,607	1,906	18	206,433	108

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EDUCATIONAL COURSE IN TELEPHONY.

BY A. J. KUSEL.

In former years the storage battery was not used to any extent, but now in the central-energy days the storage cell is most generally used. A storage battery, or secondary battery, or accumulator, as it is most generally called, is a cell for accumulating or storing electricity, and its electrical action is from the chemical changes undergone when this material is subjected to an electrical current. Electricity is not rightfully stored, but from the outer surface this seems to be the case. The current acting in one way upon the storage battery or accumulator causes the elements to decompose, but when the current is reversed and the storage battery is discharging, these decomposed particles resume their original form.

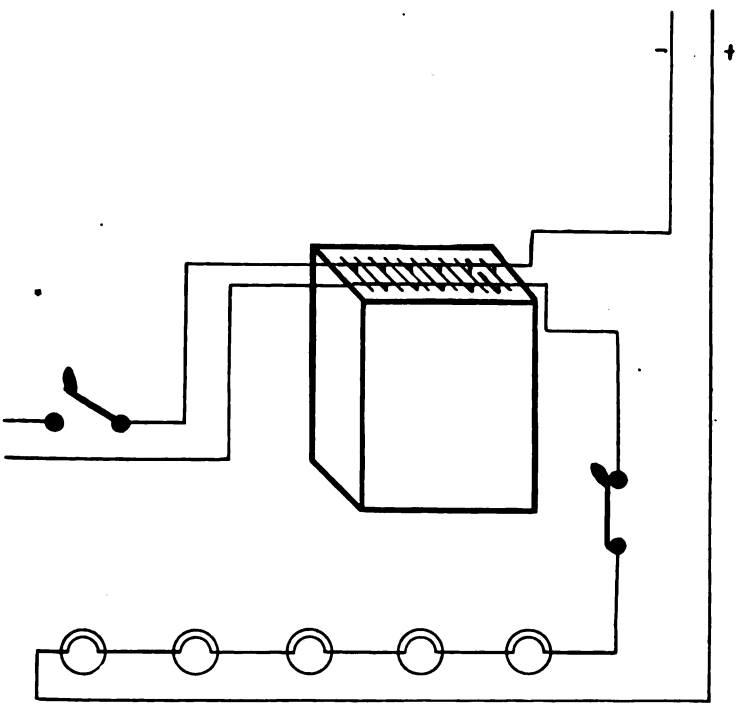

FIG. 1.

One of the oldest forms of storage cells was that of Plante. Undoubtedly this was the origination of the lead cell. He made a cell by taking two strips of lead, insulating these from each other, and wrapped these into a spiral form, each of the lead sheets being provided with a distinct terminal. They were then placed in a jar containing sulphuric acid. The action of the current, when the cell was charging, was to decompose the water in the solution, the oxygen combining with the metal of the positive plate, thereby forming peroxide of lead. The hydrogen was then deposited upon the negative plate and remained there in its original state — that of hydrogen gas. On discharging, the hydrogen combined with the oxygen, and the solution was then in the form of water, while the peroxide of lead was deoxidized, the lead remaining on the surface of the plate as spongy lead, and the oxygen reëntered the solution to compensate for the oxygen which was extracted therefrom by the hydrogen in forming water. Plante found that this method of construction enabled him to get an electromotive force (E. M. F.) of from 2 to 2.5 volts,

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as against 1.47 volts given by Grove's gas battery.

Plante's experiments did not, however, terminate with this achievement, and he next introduced a method for considerably increasing the available metallic surface of the electrodes. This plan is known as "forming" the plates, and consists of repeating for a considerable time the following series of operations: (a) charge the accumulator, (b) discharge ditto, (c) recharge, but with the charging current entering in the reverse direction, (d) again discharge. This cycle or series of reversals in charging and discharging, if kept up for several days, has the effect of causing the lead plates to become porous or spongy in character, and, therefore, by reason of the additional surface of contact between electrolyte and electrode thus provided, enables the cell to retain a much greater charge than it would otherwise do.

It is not difficult to see that this work of "forming" is of a somewhat tedious and expensive character, and with the object of reducing this process to a minimum, another inventor, Faure, conceived the idea of using plates coated with a paste of lead oxide, a plan which made it possible to use an accumulator with success after being discharged only two or three times. When first introduced, some difficulty was found in making the lead oxide paste adhere properly to the plates, and various means were devised to overcome this drawback. Scratching and indenting the lead plates was tried, but this was ultimately superseded by the plan of making perforated plates in the form of grids, the paste being pressed into the perforations. With various slight modifications in the shape of the perforations, this device has been found to answer exceedingly well, and is now very generally adopted.

When a cell is freshly charged it will be found to have an E. M. F. of about 2.25 to 2.5 volts, but after being used a short time this falls to about 2 volts, at which figure it remains until the cell is nearly exhausted. For many purposes, however, a higher voltage than this is required, and it then becomes necessary to have several cells joined in series, so as to give a total voltage equal to the number of cells multiplied by 2. Thus three cells of 2 volts each, if joined in a series, would give an E. M. F. of 6 volts, five cells would give 10 volts, and so on.

The current which a cell will accumulate or store depends upon the area of its plate — the larger the plates the greater the capacity of the cell, and further, the higher the permissible rate of discharge. As it is not always convenient to use very large plates where great capacity is required, the same result may be obtained by using a number of small plates to increase the available plate surface, but in such case the plates must be connected in parallel. That is, the positive plates must all be connected to one terminal, thus forming practically two plates divided into a number of branches.

The capacity of an accumulator is usually measured by ampere-hours. Thus an accumulator which will discharge a current of ten amperes for one hour, or of five amperes for two hours, or of one ampere for ten hours, is said to have a capacity of ten ampere-hours. As a general rule, it may be reckoned that an accumulator with its plates connected in parallel has a capacity of six ampere-hours for each square foot of positive plate surface.

Storage batteries may be charged from a bank of primary cells, or they may be supplied from any direct-current power source, or from a distinct dynamo. To use the storage battery for a current necessary to run the operator's transmitter at the switchboard it would be too expensive to equip with a charging machine. In that case the batteries may be charged from a lighting or power source; that is, providing it is a direct current. In most cases the direct current can only be secured from a street railway power, which most generally consists of a 500-volt current: in that case the cells may be charged in the manner as shown in Fig. 1. Or if 110-volt current is available they may be charged as in Fig. 2. But in no case the charging current exceeds 4 amperes per square foot of surface. In all bat-

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teries the positive and negative plates are marked, but in case the marks can not be found, the positive may be told from the negative very readily, the positive plate being brown in color. The color of the plates also denotes the condition of the battery. The positive plate should have two appearances, a smooth appearance and a dark reddish brown in color. The negative should have a bright appearance, and should be either lead or slate color. In no case should a battery be worked unless the electrolyte is mixed in right proportion. This consists of pure sulphuric acid, diluted with about four times its bulk of water, the specific gravity of the mixture being about 11.70. When preparing this mixture, the acid should be poured very slowly into the water, and never vice versa. The quantity of solution should be sufficient to cover the plates

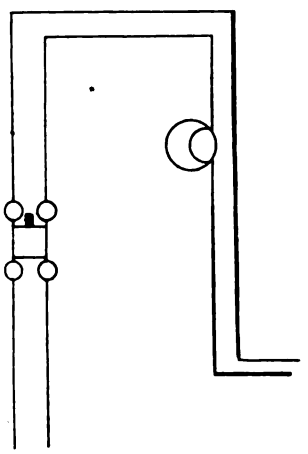

FIG. 2.

in each cell, but not to completely fill the interior of the accumulator. The direction of the current flowing from the cell while discharging is always opposite to that of the charging current.

Distilled water should always be used in mixing the electrolyte. In no case should well water be used, as this always contains impurities, and is very often impregnated with metals or alkalies. After the solution has been mixed it becomes hot. This is due to the action of the acid. The solution should always be allowed to cool and in no case should the jar that the solution is mixed in be used as the cell, as in mixing of the acid with the water a vapor arises and settles in a thin film around the top of the jar. This at once starts creeping. Creeping in a storage battery is something that in all cases should be avoided. All connections should be made on the accumulator before the electrolyte is added. The method of connection may be readily seen in the figures. Always be sure that the positive pole of the source of current is connected to the positive pole of the storage battery.

Duration of Charging. — During charging, the specific gravity of the electrolyte will slowly rise until it reaches 11.86, when the cells are fully charged, and will then gas freely, the acid turning very milky. The E. M. F. of each cell will rise till it reaches 2.25-volts when the cell is charged.

If any cell is found not to gas freely, it must be disconnected and carefully examined, any detached particles of oxide between the plates being carefully removed.

The time taken to charge cells depends on the capacity. The capacity of an accumulator is measured in ampere-hours, so that an accumulator having a capacity of 20 ampere-hours would be able to supply a current of 1 ampere for twenty hours, or 2 amperes for ten hours. Let us take an example from the following: Capacity of accumulator, 40 ampere-hours. Resistance can be neglected. Back E. M. F. of cell=2.25. Number of cells to be charged in series, 10. Resistance of dynamo, 5 ohms. The current that will pass thru the storage cells:

$$(C = \frac{E}{R} \text{ Ohm's law.})$$

$$C = \frac{25 - (10 \times 2.25)}{5} = \tfrac{1}{2} \text{ ampere.}$$

Now the capacity of each cell is 40 ampere-hours, therefore, time taken to charge the cells is:

$$\frac{40}{0.5} = 80 \text{ hours.}$$

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If, however, a current of 4 amperes is sent thru the cells, they will be charged in

$$\frac{40}{4} = 10 \text{ hours.}$$

This would be the case if the resistance of the dynamo was .625 ohms (5 ohms is a very high resistance for a dynamo), for then

$$C = \frac{25 - (10 \times 2.25)}{.625} = 4 \text{ amperes.}$$

The following instance may be given of a cell having seven plates (three positive and four negative), each plate being 6 inches by 4 inches. The capacity was found to be about 10 ampere-hours. The maximum charging current for this cell being 4 amperes, the time taken to charge it $= \frac{10}{4} = 2\frac{1}{2}$ hours. The actual time taken was 2 hours and 35 minutes.

Discharging. — During discharging, the specific gravity of acid will slowly fall. In no case must the cells be allowed to discharge below 1.9 volts per cell. When this state of things is reached, discharging should be at once stopped and the cells recharged as soon as conveniently possible. "Sparking" and "flashing" cells to see if they are charged is very detrimental; it should never be done. A handy method of roughly telling if cells are charged or not is to have a 2-volt lamp and connect it across any cell to be tested. If the cell is fully charged, the lamp will glow very brightly, but if the cell requires charging, the lamp will be somewhat dim. A portable voltmeter, however, is far more handy. If the cells are discharged too heavily the plates will buckle. If the cells have to be put out of work for a time, they should previously be fully charged, care being taken that the plates are covered with the electrolyte. A short charging should be given, say once every three weeks. This will keep the cells in good order. There is a mistaken notion that cells will last longer if they are never fully charged. Overcharging will do no harm at all, providing the charging current be not excessive. It has, however, been clearly proved that nothing tends more to destroy cells than partly charging them, and then exhausting them. When cells have begun to "sulphate," the only remedy is to overcharge them, and so get rid of the sulphate. By "sulphating" is meant the formation of white patches of insoluble sulphate of lead on the plates. It is due to neglect of the cells and careless management. If it appears, the plates should be carefully scraped, and then overcharged. In order to prevent "sulphating," caustic soda is often added to the acid. About 1 ounce to the 5 gallons of electrolyte should be added, and it is best to add it in the form of a solution — say 1 ounce of caustic soda to 5 ounces of water. To prevent "spraying" of the acid during charging, it is well to place sheets of glass over the plates to throw back any spray.

The room in which the cells are charged should be well ventilated, and metal work should not be exposed to the acid vapor, or it will be rapidly corroded. In order to protect the brass connecting parts, they should be coated with hot paraffin wax.

On no account should the accumulators be charged in a workshop, or the tools will be sure to suffer. If the charging or discharging current be too great, the paste will be driven out of the grids.

Accumulators should always be kept in an upright position.

Do not charge the accumulators without being sure that every compartment has the right amount of acid.

A piece of metal or wire placed across the two terminals, thus making a "short-circuit," is likely to injure the cell permanently.

It is usual to paint the lugs of the positive plate red. Charged negative plates are of a pale slate color and their lugs are painted black.

The poles of the charging wires can be easily found by taking a piece of "pole-finding paper," wetting it, and then putting a wire from the positive and another from the negative terminals on the paper, within about ½ inch from each other, taking care that the

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two wires do not touch; keep them in this position for a few minutes, and on removing, a red mark will be left on the paper, indicating that the wire which left the mark is the negative. If "pole-finding paper" is not to hand, take a glass of water and immerse the two wires, keeping them the same distance apart from each other as before, and the negative wire will produce a great many more bubbles than the positive.

To connect two or more accumulators in series, they should be joined up thus: Positive of the first cell to negative of the second, and the positive of the second cell to negative of the third, and positive of the third will connect on to positive terminal from the charging station.

Failing to secure sufficient E. M. F. to charge all the cells in series, the most satisfactory arrangement for charging large secondary cells is to connect them in a series forming groups, then connect these groups in parallel. The number of cells placed in groups should be decided by the E. M. F. of the charging batteries. The current required to charge accumulators varies with the size of plates. For very small cells the basis of calculation may be taken as 6 amperes per square foot surface of positive plate.

L = length of plate in inches.
W = width of plate in inches. Then,

$$\text{Current required} = \frac{L \times W}{12} \times \text{number of positive plates in single compartment.}$$

(To be continued.)

TOO MANY RINGS CAUSE A LOUISVILLE CONCERN TO SUE THE CUMBERLAND COMPANY.

One thousand dollars damages for annoyance for the unnecessary ringing of a telephone bell was the prayer of a petition filed against the Cumberland Telephone & Telegraph Company by the Hegan Mantel Company. The suit is said to be the first of its character ever filed against a telephone company.

The plaintiff states that it has been for some time a subscriber for a telephone over defendant's lines, of the number 601-A, being what is known as a "two-line" telephone, that is, one with two termini, 601-A and 601-Y. The mantel company states that it pays $6.50 per month for the service, in consideration of which the telephone company agreed to supply the service free from defects of any character.

The mantel company claims that, in violation of its duty, the defendant company has daily, for a period of at least two months, sent calls over plaintiff's line, and has caused plaintiff's bell to be rung when that number was not desired, as a result of which the officers and employes of the mantel company have been subjected to continuous annoyance and have lost much time in answering said calls and attending to the telephone in answer to the ringing of the bell, at each of which calls it would be discovered that its number was not wanted. It is claimed that these errors have been caused entirely either by negligence on the part of defendant's employes or by defects in defendant's instruments and service. The plaintiff states that it has repeatedly notified the defendant company of the annoyance, but notwithstanding this the defects have not been remedied.

TELEPHONE RATES.

The American Telephone & Telegraph Company has changed its tariffs all over the United States, so that one can now use the telephone for a three-minute period as the minimum, instead of a five-minute period, as formerly, and has made the charge for the three-minute period about three-fifths that of the five-minute period. The three-minute charge between New York and Boston is $1.25 for day time, and $0.65 for night, in place of $2 and $1, respectively, for the five-minute period.

PUT IN 153,047 MORE 'PHONES.

The Wisconsin Telephone Company and the Erie Telephone System report large gains. The former made a net gain of 235 subscribers in August, making a total of 22,505. The latter reports a net gain of 1,246 subscribers in August and a gain of 11,448 since January 1, making a total of 153,047 subscribers on August 31.

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TELEPHONE OPERATORS.

The British Post Office Department decided recently to employ women as telephonists, thus following the practice which obtains under other Governments and among private companies; but tho the step is approved, complaint is made against the scale of pay. In London a girl must begin at 11 shillings a week, and the pay during the fifth year is only 20 shillings. An article in the London *Chronicle* declares that these rates are the lowest paid in Europe, and turns to Belgium for an illustration of what is done on the continent.

There the novice starts with £40 a year, or about 15 shillings 6 pence a week, and there is an advance of £8 per year for each successive year until £88 is reached. This maximum figure amounts to about 34 shillings a week, while the highest wage for superior appointments in London is 26 shillings.

In order to bring the comparison home we may include Chicago in it, and translate from shillings into dollars. At the end of two years a competent telephone girl receives $35 a month in Chicago, or $8.75 a week. In Belgium the pay after the same length of service is $5.10, and the maximum after six years' work is $8.16. The London girl in her third year gets $4.08, in the fifth year $4.80, and her maximum is $6.24. The Chicago common rate at the end of two years exceeds the highest rates paid after long service in London and in Belgium, and there are, of course, superior salaries here for superior positions, which range as high as $50 a month.

A report of the Belgian Government is as follows:

"The telephone was introduced in 1882, and women have been employed since that date as telephonists. They have proven to be particularly apt, because the timbre of their voice is more penetrating and more agreeable than the voice of a man, and they exhibit more patience than men in dealing with subscribers."

Having proved the superiority of women for the work by this and other testimony, a writer in the *Chronicle* takes the British Government severely to task for its meanness in the matter of pay. He says: "It has molded itself on the worst models of competitive employers, and has set an example that can not fail to disgrace us in the eyes of the more generous adminstrations of the continent."

UNITED STATES LEADS IN ALUMINUM.

According to German statistical tables, the production of aluminum in 1900 was 17,035,082 pounds, against 29,242 pounds in 1885. In this total of production the following works participated: The aluminum industry works at Neuhausen, Switzerland; Rheinfelden, Germany, and Lend-Gastein, Austria, with 5,500,000 pounds; England, with 1,100,000 pounds; France, 3,300,000 pounds; United States, 7,135,081 pounds.

GLUE WATERPROOFING RECIPES.

(1) Soak the glue in water until soft; then melt it in linseed oil assisted by gentle heat. This glue is not acted on by water or dampness. (2) Dissolve gum sandarac and mastic (each 5½ drams) in ½ pint of alcohol, and add 5½ drams of turpentine. Place the solution in a glue boiler over the fire, and gradually stir into it an equal quantity of a strong, hot solution of glue and isinglass; strain, while hot, thru a cloth. (3) To plain glue add bichromate of potash. On exposure to air it becomes waterproof.

'PHONE POLITENESS.

"One of the main reasons for our success," said a prosperous Toledo merchant, "is the way in which we handle our telephone business. I have drilled every clerk to be polite over the 'phone and one departure from the rule means instant dismissal. I won't allow my employes to be surly over the 'phone or even indifferent. They must immediately take a deep personal interest in the party at the other end and, no matter how trivial the question, must reply with studied politeness. I have given a good deal of attention to this seemingly small matter and have found that the time was well spent. Many a customer has been driven from a store by rude treatment over the 'phone."

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Telephone Magazine

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Cumberland Company.

The method of the Cumberland Company is clearly outlined in the letter from Mr. Caldwell, of the Cumberland Company, in replying to the question asked by the Lexington, Kentucky, *Herald*. One of the questions asked by this enterprising paper: "Is it not a fact that the Independent telephone plants at Atlanta, Georgia, and Columbus, Ohio, have more subscribers than the Bell Company, and that they give better service than the Bell Company?" Mr. Caldwell also was asked about the exchanges at Savannah, Georgia, Indianapolis, Indiana, St. Louis, Missouri, and Richmond, Virginia. In reply Mr. Caldwell only mentions Atlanta, Georgia, and Columbus, Ohio, and says in these places the reverse is exact. Mr. Caldwell evidently was not well informed as to the situation at Columbus, Ohio, and Atlanta, Georgia. At both these places the telephone service rendered by the Independents at the present time is so far ahead of the Bell service that it does not invite comparison. It is true that they have more subscribers than the Independents, but what was their method in obtaining these subscribers? Not one that would make a telephone company prosperous, but a method which would make a large telephone directory, and up to the present time we have never heard of a telephone company paying dividends on a large directory; that is, if the directory contained subscribers who were put in at special rates in opposition to another company.

Pupin's Discovery.

What has become of the invention that the American Bell Telephone Company was said to have purchased from Prof. I. M. Pupin to telephone across the ocean?

While we may accuse the Bell Telephone Company of a great many other things, we can not say they are not progressive, and we would like to know why the possessors of such a great invention as this have not already put it into use. Is it because that it is not a success, or that they are holding these

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patents for the time when they need money, so that with the promise of these plums in sight their stockholders will dig deeper into their old stockings and come forward with their money.

Marconi Wirelessness.

Now that Marconi has made a practical demonstration of wireless telegraphy in the international yacht race, we may look for very rapid developments in the way of wireless things; but how long it will be before we obtain wireless telephony is still a hazard, and when it does come whether the Bell Company will be able to obtain control of it, and if they do, will they try to make the patents on it last for a period of thirty-five years as they have done in the past with the fundamental telephone invention.

SLUGS PROTECT SLOT TELEPHONE.

"Hand over your nickel, please, and use a slug."

This is the latest innovation introduced by subscribers to the nickel-in-the-slot automatic telephones to prevent the use of slugs instead of United States coins by persons who go into the public places where they have been installed by the Chicago Telephone Company.

The slugs are a brass composition, the size and weight of a nickel, and are kept constantly on hand.

"These slugs are protection that does protect," said the proprietor of a North Side cigar store to a Chicago *American* reporter. "When a person comes in here to call up the telephone, we take the nickel and issue the slug, and in that way we are certain we have a nickel for every call registered."

General Manager A. S. Hibbard, of the Chicago Telephone Company, said:

"The nickel-in-the-slot automatic telephones are leased to subscribers, who have to pay a nickel to the company for every token dropped in the slot, while the dime machines are operated at the company's risk.

"As to the abuse of the dime-in-the-slot automatic telephones, which are operated at our risk, if the abuse becomes too wanton we will take out the slot apparatus entirely and make the party who uses a public telephone pay cash for the privilege. This is the remedy that has been universally adopted in New York."

MENDON (N.Y.) FARMERS CLAIM THAT TELEPHONE COMPANY SOLD THEM A GOLD BRICK.

There are eight actions on the present trial term calendar brought against the American Telephone & Telegraph Company by Mendon farmers. The plaintiffs are Charles Warren, Johanna Weitzel, William Thorp, Thomas Mead, Amanda Meyers, Sylvester Wilcox, Eliza Earl and Catherine Primm. Jay K. Smith appears as plaintiff's attorney in each of the actions, with Elbridge L. Adams representing the defendant, which is nominally the Bell Telephone Company.

It is alleged that in June, 1888, agents of the company appeared in Mendon accompanied by poles, wire and a smooth story to the effect that they would like to trim several trees and erect the poles. They offered the farmers $1 for the privilege of trimming the trees.

After the dollar was paid a paper was produced for the farmers to sign as a receipt. This turned out, it is alleged, to be a grant for rights of way across the farms. The actions are brought for ejectment or for $10 for each pole. About one hundred poles were erected on the strength of the "receipts."

POLE INDICATOR.

Take a common tumbler, or any other kind of vessel. Place in the vessel two parallel small strips of lead; see that the lead is well sandpapered and clean, then fill the tumbler with copper sulphate solution. The lead strip connected to the + pole of the generator turns brown when the current flows, while the — does not change. This forms one of the handiest and best methods of finding the poles of any generator.

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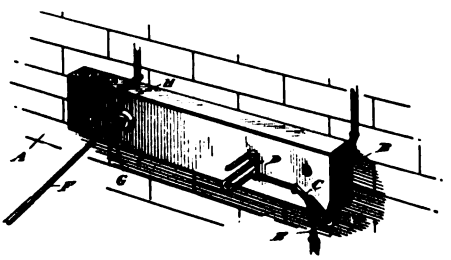
MONTHLY DIGEST OF TELEPHONE AND KINDRED PATENTS

EDITED BY CLARENCE C. BROWN.

Copies may be had, postage paid, by enclosing 5 cents for each one. Address inquiries in care of this magazine or Washington, D. C.

ALFRED DECK, OF FRANKLIN TOWNSHIP, MONTGOMERY COUNTY, INDIANA. No. 682,458, dated September 10, 1901. TELEPHONE PROTECTOR.

In this device, upon the approach of a storm, the telephone may be cut out on the outside of the building, leaving a line connected directly to the ground. It



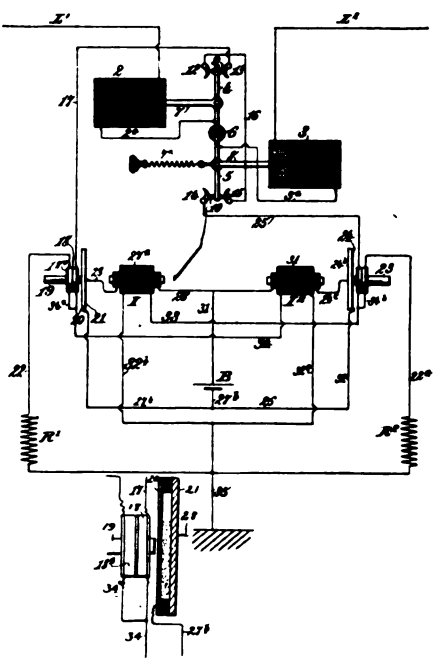
No. 682,458.

is the inventor's intention to provide a protection against lightning for the telephone as well as a lightning rod for the house. In the illustration it is shown with the telephone out.

MORRIS C. MENGIS, OF SHEEPSHEAD BAY, NEW YORK. No. 682,332, dated September 10, 1901.

This is a telephone repeater. Referring to the drawing, the reference characters L^1 and L^2 indicate parts of a telephone line looped into a repeated station. The wire L^1 leads to a solenoid 2, while L^2 goes to a like solenoid 3. These solenoids are on opposite sides of a centrally pivoted lever consisting of two parts, 4 and 5, of conducting material, connected together by a central section 6 of insulating material. The core 7 of the solenoid 2 is connected to the part 4 of the lever, and the core 8 of the solenoid 3 on the other side is connected to the part 5. A light spring, 7*a*, acts upon one of the two parts of the lever in a direction contrary to the pull exerted by the cores of the solenoids when the coils are magnetized, and said lever is held by this spring in its normal position, with a contact 9 on the part 4 pressed against a contact 13, and a contact 10 on the part 5 against a contact 14.

The tendency of the solenoids when energized is to so displace the lever as to cause the contacts 9 and 10 to break engagement with the contacts 13 and 14 and make engagement with two contacts 12 and 13, connected together by a wire, 16. The terminal of the solenoid 2 connects with part 4 of the lever by a wire 2*a*, and the terminal of the solenoid 3 has a like connection with the part



No. 682,332.

5 of the lever by a wire 3*a*. From contact 13 a wire 17 leads to one of two coils 18 on the core 19 of a telephone receiver, said two coils being wound in opposite directions. From the coil a wire 34 goes to the secondary 31 of an induct on coil 1-2, and from said secondary a wire 32*a* goes to a ground connection 35. A wire 34*a* goes from the wire 34 to the second of the two coils 18*a* on the core 19, and from the coil a wire 22 leads to a resistance R^1

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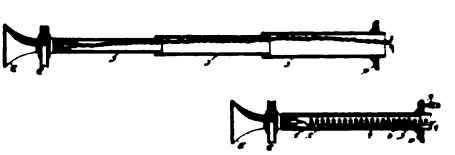
and thence to the ground connection 35. The two coils 18 and 18*a* on the core 19 being wound oppositely will neutralize each other when current flows thru both from the inside, that is, from the point 34*a* and out, but not vice versa. From contact 14 a wire 25 leads to one of two coils on a core 23, said coils being oppositely wound, like those described above. From the second of these coils a wire 33 goes to the secondary 27*a* of an induction coil 1, and from the latter a wire 32*b* goes to the common ground connection 35. From the second coil on the core 23 a wire 22*a* is led to a resistance R^2 and thence to the ground wire 35.

In front of one of the receiving devices is a microphone transmitter, which is conventionally shown as consisting of two diaphragms 20 and 21, each constructed of a different material, with carbon interposed between them. The diaphragm 21 is of non-magnetic material and is sufficiently thicker, and therefore more rigid, than the diaphragm 20 to insure a microphonic action, while the diaphragm 20 is constructed of iron or other suitable metal. From the diaphragm 21 a wire 28 leads thru the primary of induction coil 1, thence thru a battery B, and from the latter by a wire 27*b* to the other diaphragm 20. In front of the other receiver is a similar microphone, having one of its diaphragms 24*b* connected by a wire 24*c* with the primary of the induction coil 1-2 and from the latter thru the wire 31 to battery B. From the second diaphragm 24 lead the wires 32, 26 and 27*b* to the other pole of battery B. The resistance R^1 is substantially equal to the resistance of the line L^1, and R^2, to the resistance of a line L^2, for a purpose presently explained.

The operation is as follows: The spring 7*a* acting upon the parts 4 and 5 of the lever, as described, conversational currents will traverse the solenoids 2 and 3, without affecting said lever the circuit over line L^1, being thru solenoid 2, wire 2*a*, lever part 4, contact 13, wire 17, the coil 18 on core 19, wire 34, secondary 31, and wires 32*a* and 35 to ground. These currents will not flow in any material degree over wire 34*a* and the second coil 18*a* on core 19 because the resistance R^1 is greater than the resistance along the circuit just traced, and core 19 will therefore be magnetized by only the coil 18. The impulses produced will thus affect the diaphragm 20 and alter the resistance of the battery circuit 28 and 27*b*, which includes the primary of the induct on coil 1. The pulsations in said primary will be reproduced in the secondary, but with much greater electromotive force, which will pass to ground on one side over wires 32*b* and 35 and over wire 33 to the point where wire 34*b* branches off, at which point the current will divide and pass equally thru both the coils on the core 23, one-half going to line L^2 over wire 25, contact 14, lever part 5, wire 3*a*, and solenoid 3, and the other half going to earth thru the resistance R^2. The latter being equal to the resistance of L^2, this division of the current is obtained and as the equal divisions pass thru the oppositely wound coils on the core 23 they produce no effect upon the diaphragm of the microphone. The repeating operation in the opposite direction over line L^2 can easily be understood from this description, as it is a repetition of the steps explained. It will be observed that since the current from the secondary of either induction coil 1 or 1-2 is split and divided between two circuits, one of which includes the line, while the other contains a resistance equal to the line, the wire on the secondary of each induction coil must have twice the number of turns that would be required if the current traversed the line only, and this is found in practice to be the fact.

ELIAS E. RIES, OF NEW YORK CITY. No. 681,812, dated September 3, 1901. TRANSMITTER EXTENSION.

This invention is placed in the hands of the transmitter on the end of tubes which telescope into one another for use on desks. The transmitter may be



No. 681,812.

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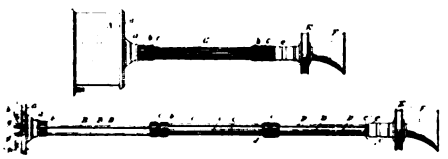
pulled out when in use and put back when not in use. The drawing illustrates this invention.

ELIAS E. RIES, OF NEW YORK CITY. No. 681,813, dated September 3, 1901.

This is similar to the invention spoken of in the preceding invention, only instead of tubes, rods are used.



No. 681,813.

These rods pass thru insulating material and serve as conductors for the transmitting currents.

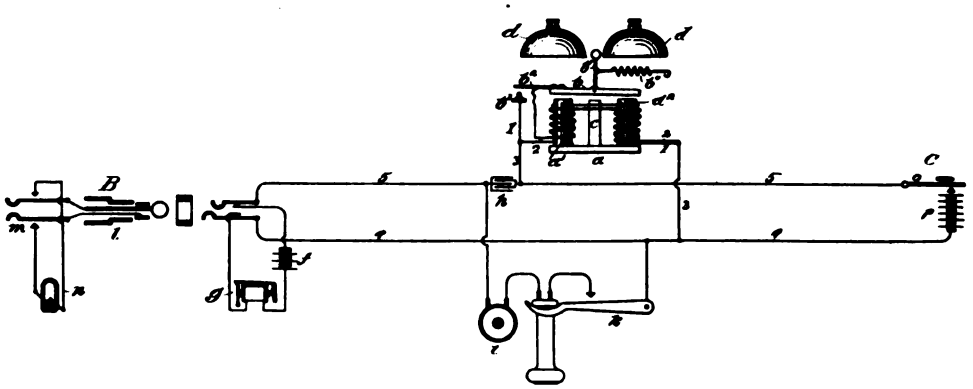
CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO. No. 681,744, dated September 3, 1901. TELEPHONE CALL-BELL.

The invention consists of the combination, a polarized bell having a centrally pivoted armature, of two windings on the electromagnet of the bell and switch-contacts carried by the pivoted armature of the bell controlling the circuit thru one of the windings, the windings being connected in the circuit differentially with respect to each other and that which is normally open-circuited having a greater number of ampere turns than the other. The armature of the bell should preferably be given a light bias by means of a spring tending to draw it normally to one side to break the circuit thru the greater winding.

This bell is illustrated in the drawing herewith, which shows it diagrammatically connected in the circuit of an extension line with means of applying either alternating or continuous current to the line for operating the bell.

The electromagnet a^1 a^2 has two windings. These two windings are connected in circuits 1 and 2, respectively, which are multiple branches of the circuit to the bell, the connections of each winding with the circuit being the reverse of those of the other, so that the windings act differentially upon the core; but the winding in circuit 2 has a greater number of ampere turns, for example fifty per cent more than the winding in circuit 1.

The armature b carries a movable contact b^2, which is adapted to be brought against a fixed contact stud b^3 when the armature is in one position, and the armature is acted upon by a light spring b^4, which tends to draw it normally into its other position. The conductor 2 thru the bell includes the switch contacts b^2, b^3, and thus the path thru it is normally broken.



No. 681,744.

The multiple branches 1 and 2 of the bell are connected in a bridge 3 of the line circuit 4 and 5, which extends from the station A, where the bell is assumed to be located to a central station B and to another sub-station C. The line is adapted for the automatic operation of a call signal in the central office and is furnished there with a bridge closed in the terminal spring jack of the line, in-

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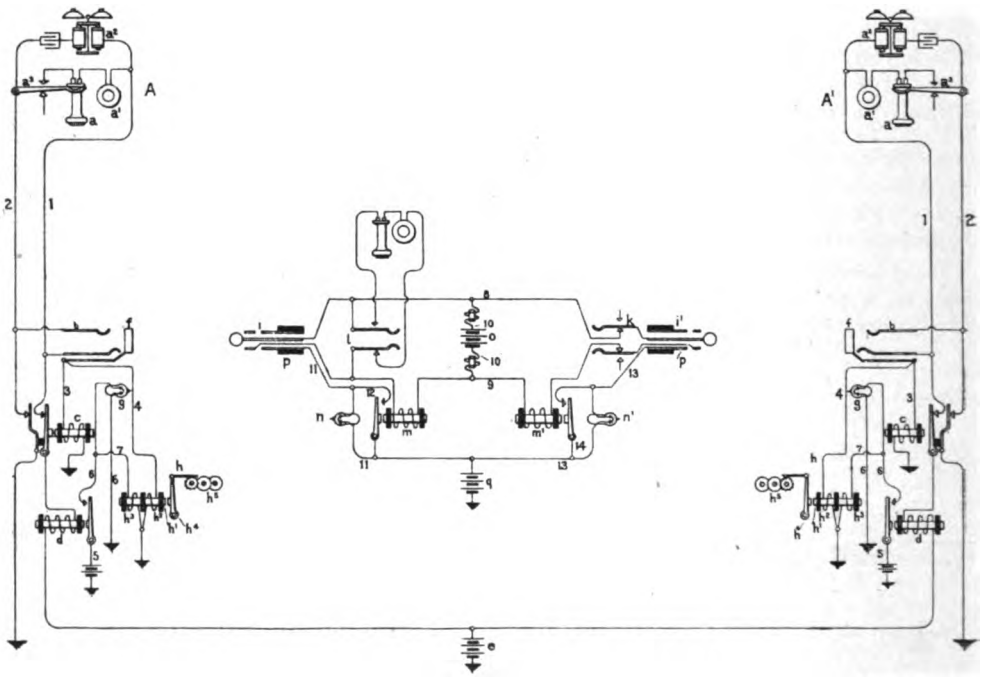
cluding a battery *f* and a visible signal *g*. To break the circuit thru the bell while the line is not in use, condenser *h* is interposed in the line which is controlled by the telephone switch *k*, which thus completes the circuit of the battery *f* when the telephone is taken for use. Means for ringing the bell at the station A is indicated at the central office B as a plug 1 for insertion in the spring jack, the line contacts of which may be connected by means of a key *m*, with the poles of a generator *n* of alternating calling current. The sub-station



No. 681,742.

C by means of a key *o*, normally open, which is arranged to close a circuit of the line 5, 4 thru a battery *p*. The bell at the station A thus arranged in accordance with this invention may be rung either by means of the alternating source of current at the central office B or by the continuously acting source of current at the sub-station C. When the alternating current is applied to the line, it finds circuit thru the condenser *h* to the bell, where it finds a closed path thru the conductor 1, including one of the windings of the electromagnet in proper direction with reference to the permanent polarity of the armature to throw the armature out of its position of rest, thus causing the tongue b^1 to strike one of the gongs *d*. In this movement of the armature the circuit 2 thru the bell is closed at the contacts b^2, b^3, and the path thus closed diverts current from the path 1, which, the winding in path 2 being more powerful, tends to reverse the polarity of the magnet, and thus to throw the armature back to its first position. The time required for this action depends upon the natural period of vibration of the bell, to which, as usual, the source of alternating current is adapted. Hence the reversal of polarity of the calling generator *n* occurs during the return of the armature to its initial position, and the winding in conductor 1 becomes effective in maintaining the reversed polarity of the electromagnet and driving the armature to its initial position. Thus a strong blow is struck upon the other gong in the return of the armature independently of the strength of the spring b^4. The action is in effect that of an ordinary polarized

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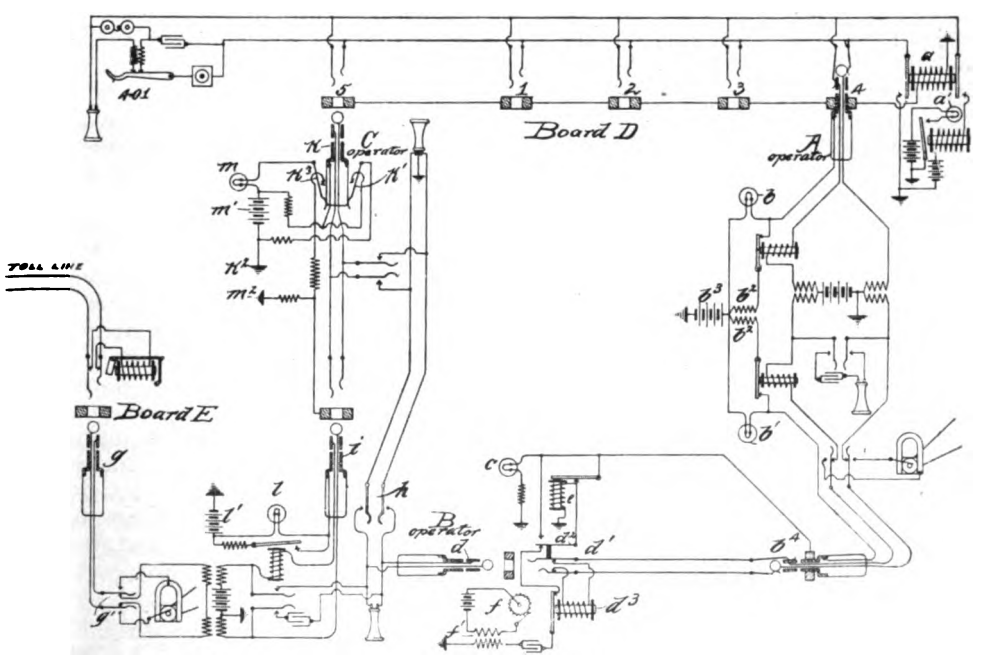
bell when actuated by an alternating current of suitable period. When in ringing the bell from the sub-station C the battery *p* is applied to the line by depressing key *o*, this battery finds circuit thru the winding 1, as before, and being adapted in polarity for the operation of the bell magnetizes the core in proper direction to bring the contact b^2 against its anvil b^3, and thus to reverse the polarity of the electromagnet and effect the return of the armature. The armature is thus thrown into rapid vibration and the bell is rung.

CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE. No. 681,742. September 3, 1901. CONNECTION-COUNTER FOR TELEPHONE LINES.

This is a counting device for use at the central station, one for each line. It is arranged to make registration or counting by the system of a circuit, consecutively closed at two points; one, a subscriber's station and the other at the switchboard. The illustration shows this invention in use with the regular form of switchboard.

JAMES I. MCQUARRIE, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO. No. 681,724, dated September 3, 1901. TELEPHONE EXCHANGE SYSTEM.

This invention is a supervisory, an order system for a multiple switchboard. One feature of this invention is of utility in connection with systems employing a multiple switchboard for one group of telephone lines and another switchboard of any type separated from the multiple switchboard for another group of telephone lines, between which boards apparatus is disposed for connecting subscribers upon one board with subscribers upon the other board. In systems of this character it is intended to assign an operator one section of the multiple board, whose sole duty it is to connect or disconnect at her section trunk lines extending between the boards with or from calling or called lines. This operator preferably is not informed whether the line with which she is to establish connection is a calling or a called line, but is merely informed of the number of the line jack into which she is to insert a trunk line plug,



No. 681,724.

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it being the duty of the other operators in the system to perform the remaining acts in establishing a connection. This invention provides an improved testing system, whereby the trunk-line operator may absolutely determine the condition of use of the selected line, thus obviating a false test when the trunk-line operator is instructed to make connection with a calling subscriber's line at her section. If a subscriber of the multiple switchboard should desire a connection with a subscriber at the other board, the operator at the section containing the calling subscriber's line annunciation by inserting an answering plug would establish a condition for erroneously indicating to the trunk-line operator when she tests that the line is busy if it were not for my improved test system. This feature of the invention in its preferred embodiment consists in establishing thru the agency of apparatus associated with the switching appliances a test which is distinctive from the test regarded by the operators in establishing connections between subscribers of the same multiple switchboard, this special test being preferably established in part thru the agency of the connecting apparatus employed in answering a call received at any of the sections of the multiple switchboard, so that the trunk-line operator upon noting this special test or upon noting that the line is not in use will finish the connection. If she should note the ordinary test, unaccompanied by the special test, she would inform the calling subscriber that the line was busy.

A second feature of the invention consists in apparatus located at the different operators' boards for automatically effecting the operation of signal appliances which will indicate to the operators the acts they are to perform in manipulating the switching apparatus. This feature of the invention in one of its aspects may generally be described as consisting in an operator's indicator at one board or section, a source of current for operating the operator's indicator or signal, and means controlled by another operator for governing the operative effect of the current as it flows thru the signal. It may provide a plurality of paths for the current from the source, more or less of which are closed in effecting the operation of the signal. In another embodiment of the invention two sources of current in combination with apparatus which would serve to cause the current from the two sources to flow in opposite directions thru a signal, so that the electromotive forces would oppose each other to maintain the signal in one condition of use, the switching apparatus being adapted to rearrange the sources of electricity to increase the effective current flowing thru the signal to place the same in another condition of use.

By reference to the accompanying drawing, which illustrates the preferred embodiment thereof. This drawing is a diagram of the circuits of a subscriber's line and a toll line entering different switchboards with the usual operator's apparatus for uniting the lines in the subscriber's switchboard and trunk lines for uniting the two lines thus entering the switchboard.

The apparatus at the subscriber's station comprises a call bell, a transmitting and a receiving telephone switch, and condenser. The circuit is normally completed thru the bell and condenser, but when the telephone is taken for use the telephone switch closes the bridge of the line thru the transmitter and a winding of the induction coil and also completes a local circuit of the transmitting telephone containing the condenser and the other winding of the induction coil.

In the drawing we find illustrated a subscriber's station 401 connected with the sections of a multiple switchboard D, the line being associated with a familiar relay apparatus *a* for controlling the line indicator *a'*. The test rings of the spring jacks are grounded thru a coil of one of the relays, as shown. The sections 1, 2, 3 and 4 are ordinary sections of multiple switchboard at which calls may be initiated. Section 5, preferably, has no line annunciators and is attended by a trunk-line operator for establishing connection between subscribers of the multiple board and the subscribers at any other board than board D. The operator at section 4, whom we may term the "A" operator,

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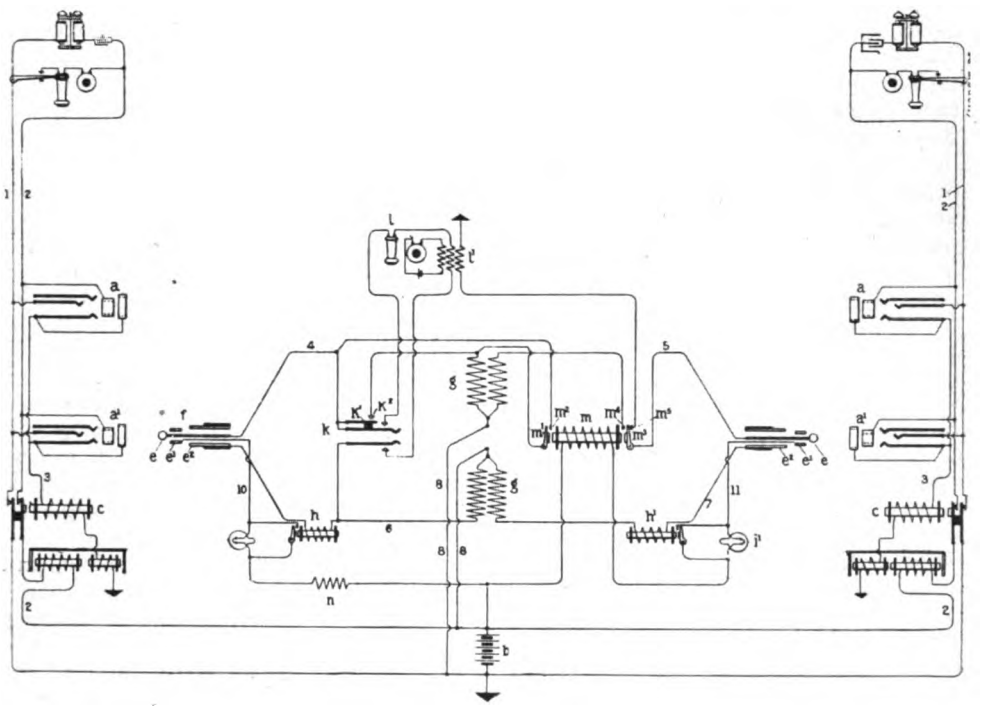
is provided with several pairs of cords and plugs. Associated with the tip and sleeve-strand of each cord circuit or line connecting apparatus is the apparatus illustrated, which is now commonly employed in telephony. Between the third or test thimble contacts of the plugs is included a conductor containing clearing-out signals b, b^1, about which shunts are established when the armatures of the relays included in the sleeve-strand of the cord circuit is included, a grounded conductor including battery



No. 681,743.

b^3 being connected between the helices of the induction coil. The coils b^2 b^2 of the induction coil are thus each included in one local circuit, current being induced in one local circuit from the other local circuit for the purpose of testing. The answering plug is inserted within a line jack of a calling subscriber 401. The connecting plug is inserted within the spring jack b^4 of a trunk line extending between the A operator and the B operator located at a switchboard E. The cord-connecting apparatus is connected, as shown, when a subscriber of the multiple switchboard desires connection with a subscriber of the other board. Upon the insertion of the connecting plug in the jack b^4 sufficient current is directed from the battery b^3 thru the lamp c to cause the same to glow. The B operator thereupon momentarily places the plug d within the trunk-line jack d', whereby the three springs of the jack are removed from their normal contacts, the spring d^2 being brought into engagement with its alternate contact to establish a path of lower resistance for the current from battery b^3 thru the relay e than the branch including the lamp c affords, the said relay being thereupon energized to attract its armature, which serves to close another path of low resistance thru the relay, whereby upon the redrawal of the plug d of the armature of the relay remains attracted. The circuit from the battery b^3, including the said relay, affords a path of lower resistance than the circuit including the lamp c, the said lamp thereupon being extinguished. The current thru the indicator b' is by

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the same means increased sufficiently to cause the lamp to glow. The parts at the jack *d'* are indicated in the position they occupy when the plug *d* has been withdrawn.

CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, AND FRANK R. MCBERTY, OF EVANSTON, ILLINOIS, ASSIGNORS TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS. No. 681,743, dated September 3, 1901. SWITCHBOARD FOR TELEPHONE LINES.

This is a common battery system. In the illustration two telephones are shown entering the switchboard. The usual wiring is used in the telephone. The line circuit is adapted for closure serially thru the receiving and transmitting telephones, but the circuit thru these instruments is normally broken at the telephone switch, while the call bell is interposed in a permanent bridge of the line, together with a condenser, which prevents the passage thru this bridge of current from the central battery. The line conductors 1 and 2 from this telephone equipment are led to the line terminals of spring jacks *a* and *a'* in a telephone switchboard, and they are further extended to the poles of a central calling battery *b*. The actuating magnet of a self-restoring line annunciator is connected in the extension of line conductor 2. The continuity of both extensions is controlled by an electromagnetic switch or cut-off relay *c*, the actuating magnet of which is located in a portion 3 of a local circuit battery, which local conductor includes also the restoring magnet of the line annunciator. The spring jacks and the plugs adapted for use with them may be of the type described in Patent No. 563,-333, dated July 7, 1896, while the line annunciator may be that commonly known as the "self-restoring drop," used with branch terminal switchboards. The plugs adapted for use with these spring jacks have, as described in the patent before mentioned, three contact pieces — a tip, a short ring and a sleeve — these being designated in the drawing *e*, *e'* and e^2. The contact pieces *e* of two plugs *f* and *f'*, which constitute a pair for uniting two lines, are connected together by conductors 4 and 5, each of which includes a winding of the repeating coil *g*. Similarly, contact sleeves e^2 are united by other conductors 6 and 7, which traverse other windings of the same repeating coil. At the points of junction of conductors 4, 5 and 6, 7 of the plug circuit the terminals of a bridge wire 8 are applied. This bridge wire includes the common source of battery for exciting the sub-station transmitters, which may in practice be the battery *b*. Supervisory relays *h* and *h'* are interposed in conductors 6 and 7, these relays being adapted to control secondary supervisory signals *i* and *i'*. An operator's listening key *k* is provided for connecting the operator's telephone *l* into a bridge of the plug circuit. The conductor 4 of the plug circuit is divided into two branches, each of which is normally interrupted. One of the branches controlled by auxiliary switch contacts k^1 k^2 of the operator's listening key. The other is controlled by switch contacts m^1 m^2 of a special relay *m*. Conductor 5, leading to the tip of plug *f'*, is likewise normally interrupted at other open switch contacts m^3 m^4 of the relay *m*, but the portion leading to the plug is connected thru a resting contact m^2, forming the terminal of a tertiary winding of the operator's induction coil *l'*, which winding is of high resistance. Contact rings *e'* of the plugs *f a f'* form the respective terminals of two conductors *b*, which are designed to be brought into association with the conductors 3 in the spring jacks to form complete circuits therewith. Each of the conductors 10 and 11 includes one of the signal lamps *i* and *i'*, and conductor 10 includes a resistance coil *n*. A supervisory signal associated with each supervisory relay *h* or *h'* is controlled by this relay by means of a shunt about the signal traversing the switch contact of the relay. Taking the telephone from its switch for use at a substation automatically initiates the call, liberating the target of the line signal, and thus calling the attention of the operator. The attendant responds to the call by inserting an answering plug *f* into a spring jack *a'* of the line. As the plug is thrust into the jack the tip makes contact successively with the

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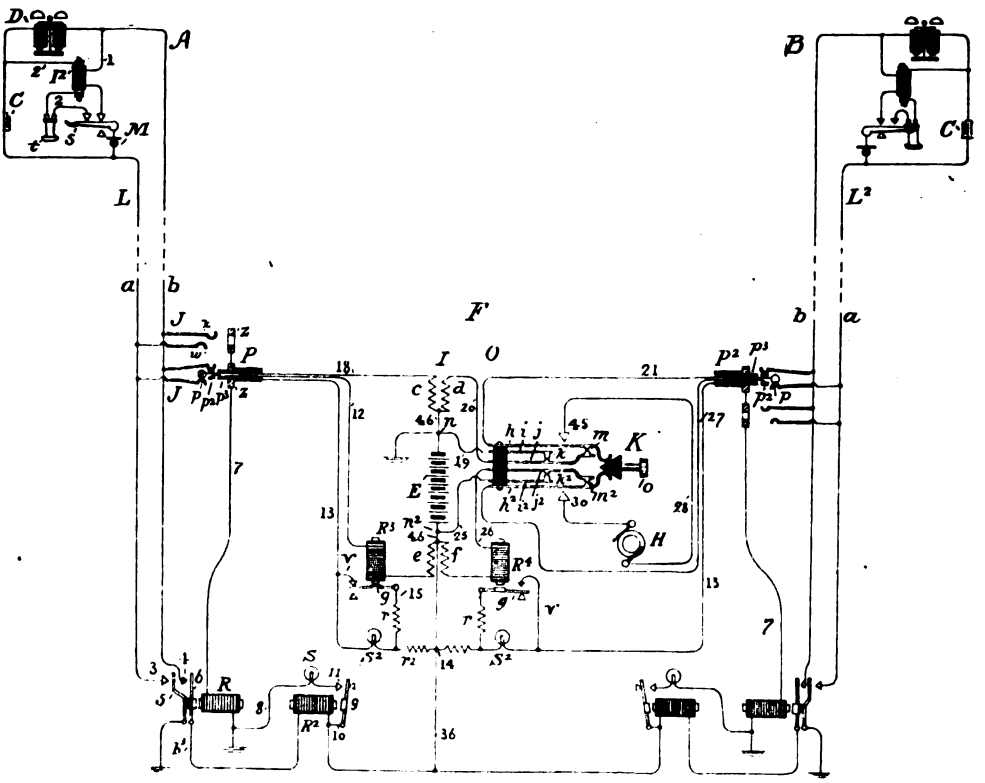
thimble of the spring jack with the local contact spring in the jack, and finally with the short line spring connected with line conductor 1, but none of these contacts produce any sound in the telephone of the calling subscriber, since the circuit terminating in the plug is opened at the switch contacts of relay *m*, both at the listening key *k* and at the relay *m*. The ring contact *c'* of a plug also connects momentarily with the thimble of the spring jack, but does not alter the tensions of the line, leaving the line disconnected from the battery. The restoring magnet of the line annunciator is also energized and resets the indicator of the annunciator. The operator now depresses her listening key, whereby the conductor 4 of the plug circuit is completed and the battery *b* is applied to the line circuit for exciting the substation transmitter. Having learned the order of the calling party for the line called for, the operator tests the line called for



No. 682,152.

potential of this part, since both contact pieces are connected with the same pole of battery *b*. Finally the sleeve e^2 makes connection with the thimble at the same moment that the tip *c* registers with the short line spring, whereby the line circuit is completed. The ring contact *e'* also comes to rest under the local contact spring of the jack, closing the local circuit 3-10. The last mentioned condition results in the cut-off relay *c*, which therefore severs the normal ex- in the usual way, obtaining, if the line be busy, a click in the telephone, due to the formation of current from the test ring thru the tertiary winding of the induction coil *l'*. Finding the line free, however, the operator thrusts the plug into the spring jack tested. In its progress into the jack the tip of the plug makes contact successively with the thimble, the local spring and the line spring, but since the tip is disconnected from the portion of the plug circuit lead-

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ing to the telephone of the calling subscriber the latter is not disturbed by any unnecessary impulses of current. When the plug reaches its place in the spring jack, the conductor 7, which is permanently connected with the battery *b*, is applied to the line conductor 2. At the same moment the ring *e'* makes connection with the local spring of the jack, and so effects both the disconnection of the normal extensions of the line thru the agency of the cut-off relay of the line and the completion of conductor 5 of the plug circuit by means of the relay *m*. The movement of the switches of the relay *m* also closes the bridge in the conductor 4, leading to plug *f*, in multiple with the circuit closed in the operator's listening key. The operator now disconnects her telephone, breaking the branch of conductor 4, controlled by the telephone key, but this act is not attended with any disturbance in the current traversing the line to the calling subscriber. The listening subscriber hears during the preliminary work of switching only the single click in the telephone produced by applying a current for exciting the substation transmitter when the operator's listening key is closed. After the completion of the connection and the calling of the party wanted, the response of the latter closes the line circuit at the substation called. After connection is thus established between lines supervision is effected by means of signals *l* and *l'* in the usual way, the lines being disconnected when both signals indicate the replacement of the telephones on the switches at the substations.

ALMON B. STETSON, OF MALDEN, MASSACHUSETTS, ASSIGNOR TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS. No. 682,152, dated September 3, 1901. TELEPHONE EXCHANGE APPARATUS.

This is a scheme to obviate the battery click on common battery systems. Referring to the drawing, when the ringing key K is operated and it springs *h* h^2 forced by pressure of the button *o* into contact with terminals 45 30 of the call generator, the alternating current from the generator flows over the line L^2 for the operation of the bell at the substation B. Owing to the capacity of the main conductors the line becomes statically charged. The subsequent release of the key disconnecting the call generator and reconnecting the points *m* m^2 enables the line to discharge, or in other words, to deliver a return-current impulse, which, unless prevented, passes thru the induction-coil windings *d* and *f*. This discharge impulse inductively develops a similar current in the other winding *c c* of the induction coil, which passes thru the cord conductors of the answering-plug section and over the substation circuit connected therewith, including the substation receiver *t*, produces the objectionable click in the latter, but when pursuant to this invention the key is provided with the auxiliary springs *i* i^2, serving, in coöperation with the springs *j* j^2, as a circuit-closer for the normally discontinuous alternative path around the coil winding comprising the conductors 19 and 25 and the battery E and adapted on the release of the key to short-circuit the said coil windings *d* and *f*, the induction coil remains unaffected by the discharge and the disturbing noise is not manifested in the receiver *t* at station A, for under such improved conditions the key is obviously arranged in such a manner that its release first severs the call-generator connection at the contacts 45 30, next closes the connection at *m* m^2 between the springs *h* h^2 and *j* j^2, and lastly severs the connection at *k* k^2 between the springs *j* j^2 and *i* i^2.

At the moment when two sets of contacts *m* m^2 and *k* k^2 are both closed, it will be seen that at the points *k* k^2 two parallel routes present themselves to the discharge or return current of the line, one composed of the induction-coil helices *d* and *f* and the battery E and the latter short-circuiting the said helices and substantially containing the said battery alone. Since the resistance of the latter is extremely low relatively to that of the former, practically all of the said discharge current passes that way, being thereby diverted from the induction coil, which remains unaffected. As a consequence, the annoying click or noise is prevented.

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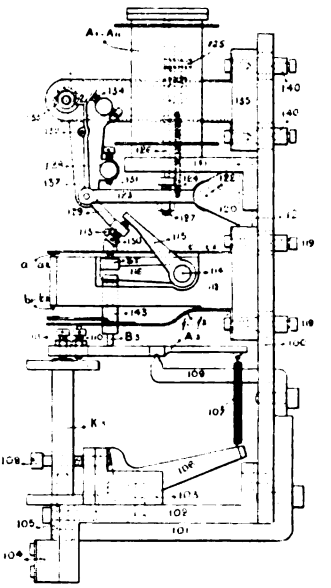
CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE. No. 681,860, dated September 3, 1901. SERVICE METER FOR TELEPHONE EXCHANGES.

This is a device to be used where measured service has been adapted to keep track of the whole number of calls made by the operator. It is arranged to be operated with any set of cords on the board. The drawing shows it in connection with the switchboard of the common battery type.

LARS MAGNUS ERRICSSON, OF STOCKHOLM, SWEDEN, ASSIGNOR TO THE AKTIEBOLAGET L. M. ERRICSSON & CO., OF SAME PLACE. No. 681,878, dated September 3, 1901. TELEPHONE SWITCH APPARATUS.

The object of this invention is to connect automatically metallic circuits of telephone subscribers with a likewise metallic circuit leading to a central exchange station.

The apparatus is primarily intended to be installed in places having a small number of telephone subscribers connected by a main circuit with a central exchange of some size. It is evident, however, that it can be used in any other telephone system, even a single wire or earth system, if it is desired to save wire. Its greatest significance, however, lies in the fact that in very



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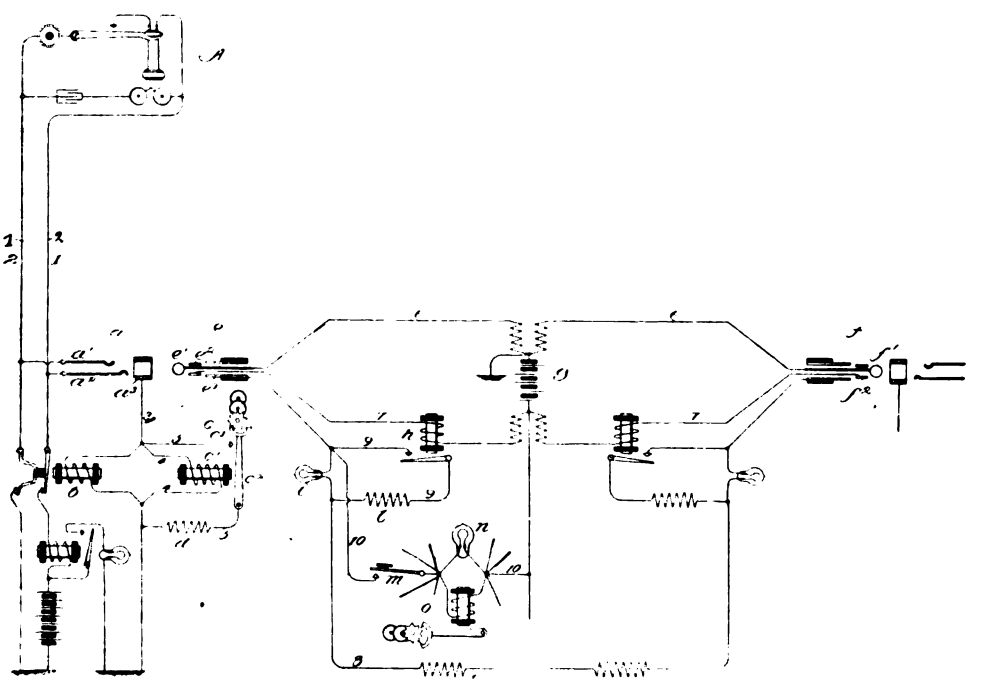

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small systems with but slight changes of development it completely fills the place of a manually-operated switchboard, thus doing away with the operating cost, which is usually quite burdensome in plants of the kind. In its construction, attention has, moreover, been paid to a strict adherence to the principles of maintaining an electric equilibrium of the two branches of the line, which principle is more especially of importance in long telephone lines, as well as to avoiding a reduction in efficiency by the presence of a shunt between the branches of a resistance coupled into them.

TELEPHONE OPERATORS REFUSE TO WEAR UNIFORM.

Some of the employes of the Pittsburg & Allegheny Telephone Company resent the spirit of paternalism displayed on their behalf by the company. It seems that recently an order was issued directing the girls to appear in a certain uniform. This included black serge skirt, black waist, black tie and white collar. While the uniform would be decidedly becoming for some of the employes, others say it detracts from rather than enhances their charms, and absolutely refuse to wear it. It was stated that the indignation of some of them was so intense that it led them to offer their resignation. Apart from the effect, or alleged effect, on their beauty, the girls assert that when so many of them appear on the streets wearing this garb they are readily recognized as "P. & A. girls," and they do not wish to carry about with them the insignia of their profession.

When the manager of the company was asked about the order, he said that as far as he knew there had been no complaints and no resignations. The order, he said, was simply one that was issued by all telephone companies, and concerned the attire of their employes. Such orders are issued twice a year, on May 1 and on October 1. The company, he said, cared as much for the welfare of its employes as to aid them in the warm and cold seasons. In the summer, light attire was allowed, while when the cold days came again, a return was made to the warmer clothing. The company, he asserted, had no interest in enhancing or detracting from the charms of any of its employes, but it was better that some kind of simple and inexpensive uniform dress should be prescribed. Then there was no tendency to overdress or to become extravagant, he said. He thought the terms of the order justified it and was sure there would be little trouble about its enforcement.

TELEPHONIC COMMUNICATION WITH ITALY.

Very shortly Italy will be in possession of its first international telephone connection. The new line is almost completed, and runs between Milan, Turin and Paris via the Mont Cenis. A few months later will witness the inauguration of a second international telephone line between Milan and Zürich. There only remains now to be constructed a comparatively short section between Como and Chioasso on the Swiss frontier. The establishment of these lines will have the effect of placing Italy in telephonic communication with London by way of Paris, and with Berlin thru the Zürich line. It is rumored, however, that negotiations will shortly be entered into with a view to the construction of a direct telephone line between Milan and Berlin. Many improvements in the inland telephone and telegraph service are also reported to be engaging the attention of the authorities in Italy.

THE NEW ERICSSON SERIES.

Part 6 Ericsson Series is just out. It is published by the Ericsson Telephone Company, 296 Broadway, New York city, U. S. A. It is a pamphlet with cuts on front and back outer covers and contains five pages of important telephone information. The series is issued in parts at regular intervals, in convenient form for future use. Persons interested in telephones and telephone supplies should keep up with this series. These people make a specialty of equipment for exchanges.

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TELEPHONY.*

BY DR. V. WIETLISBACH.

INTRODUCTION.

The telephone, by the aid of electricity, makes instantaneous transmission of speech a practical possibility. Verbal communication may thus be established between persons in places far distant from each other, distance being, within certain limitations, a matter of indifference. When first invented, it sufficed if the telephone spoke distinctly over a very short distance. At present, it is a matter of no very great difficulty to talk over a line a thousand miles long. Disregarding cost of construction, it may safely be asserted that telephonic speech can be transmitted any distance.

As with every great invention, it has been found subsequently that long ago many investigators had experimented in the same field, or had at least made observations which may be regarded as anticipations. The telephone is peculiar in this regard only for the large number of these alleged anticipators who appeared upon the scene after it had become a great financial success.

About 1854, Bourseul described an apparatus with a movable diaphragm elastic enough to reproduce all the vibrations caused by the voice. This plate was intended alternately to open and close the circuit of a galvanic battery, and the intermittent current thus produced was to be conducted by a wire to a place some distance off, there to reproduce the voice. Bourseul experimented considerably, but did not succeed in constructing a practical receiver, and would reconvert the intermittent electric waves into atmospheric vibrations. Philipp Reis was the first to succeed in doing this. About 1868, probably without any knowledge of Bourseul's labors, he constructed a similar transmitter, and also invented a receiver, making use of the phenomenon first observed by Page in 1837, that iron, subjected to very rapid magnetic changes, produced a tone.

If a thin iron rod be put inside a coil of wire, in circuit with a strong battery with a Neeff circuit-breaker, the iron rod is given a trembling motion. If it be attached to a sounding-box, the result will be a loud tone, the rate of whose vibrations will correspond with that of the circuit-breaker. Reis used a vibrating diaphragm instead of the circuit-breaker, and thus constructed the first electric apparatus which would transmit acoustic waves to any considerable distance. For reasons attributable not to the principle of the instrument, but to its construction, he was able as a general thing to transmit only melodies or songs, but no spoken words.

On March 7, 1876, Alexander Graham Bell patented an instrument which made it possible to transmit speech. This instrument became well known thru the Universal Exposition held in Philadelphia in the same year. Its introduction in a commercial way as a means of communication was immediately taken in hand, and today more than five hundred thousand telephones are in daily use. Bell's telephone is mainly serviceable as a receiver, but as such is far inferior to the microphone, the most important types of which were invented in 1877 by Edison, and in 1878 by Hughes and Hunnings.

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*Owing to the number of inquiries received calling for the articles of Dr. V. Wietlisbach, on Telephony, which were published in 1895, in *The Electrical Engineering and Telephone Magazine*, the back numbers having become exhausted, and as we are unable to supply the back numbers containing these interesting articles, we feel that it will not be out of place to make a reprint and publish them in the current volumes of THE TELEPHONE MAGAZINE. We know that this method will be appreciated by those who desire to secure these articles, and we feel that they will be of value to all our readers, as undoubtedly they are the most complete set of articles bearing upon telephony ever published.

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SOUND VIBRATIONS.

A knowledge of the physical laws underlying speech is indispensable for an adequate understanding of the mode of operation of the telephone. Sound, the basis of speech, is due to vibrating movements of the molecules of air, which at regular intervals alternately give rise to atmospheric condemnations and rarefications; that is, to changes of pressure. As soon as these reach the tympanum of the ear, the auditory cavities and organs are thrown into corresponding vibrations and, in a manner not yet wholly explained, the branches of the acoustic nerve are excited and the sensation of hearing evoked in the brain. Helmholz observed the important fact that the ear analyzes the motion thus communicated into its primary elements, which are usually designated as harmonic or sine vibrations. A harmonic vibration is produced when an elastic body is thrown out of equilibrium and left to itself. It will oscillate about its point of equilibrium until the molecular friction and the friction of the surrounding air restore it to rest. The motion of a tuning fork is an illustration in point. If to the fork be fastened a sharp metal point, and, while the fork is in vibration, this be rapidly drawn over a glass plate covered with soot, the curve represented in Fig. 1 will be produced. If the ordinate represent the time t, and the distance between the prong of the fork and the position of rest at the time t be designated by y, the analytic expression of the curve will be:

$$y = A \sin (2 mnt - Z = A \sin (mt - Z).$$

FIG. 1.

This curve is determined by the amplitude of vibration, A, the number of vibrations per second, n, and the phase, z, i. e., that particular moment of time when the prong of the fork begins to move for the first time during the experiment passes the zero point. The vibration of the prongs is communicated to the surrounding air, and produces alternate atmospheric condensations and rarefications. These recur periodically in correspondence with the initial vibrations of the tuning fork and are propagated in all directions, in the elastic medium of the air, at a speed of 3.32 m. per second. The separate molecules of air vibrate about their point of equilibrium exactly as do the prongs of the tuning fork, the two motions being of an exactly similar nature.

The loudness of the sensation produced in the ear by a sound vibration depends upon the intensity of vibrations. If p represents the density of the air, the intensity of vibration will be:

$$J = p (A.n) 2$$

That is, in proportion to the square of the product of the amplitude and the number of vibrations per second. For this reason, high tones affect the ear more powerfully and are perceptible at a much greater distance than deep tones of the same amplitude.

Let $T = l n$ be the period of the vibration, in other words the duration of the vibration in seconds; and let $m = 2 n n$ be the frequency of the motion. These expressions facilitate the analytical representation of the motion. The celebrated mathematician Fourier has shown that any curve can be separated into a series of simple sine curves. What Fourier's formula explains mathematically, the ear performs unconsciously. For instance, the curves in Fig. 2 are analyzed by Fourier's formula into the three simple sine curves 1, 2 and 3 there shown. We see that the waves 2 are only half as long as the waves 1, the waves 3 only one-third as

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long. The ear makes the same analysis. When acted upon by a movement of the air corresponding to the curve in Fig. 2, a sensation is produced, which is recognized by a trained ear as the fundamental tone, the octave and the twelfth, these being the names given in acoustics to the three sets of harmonic vibrations which are numerically in proportion as 1 : 2 : 3. The fundamental element underlying sound sensation is, therefore, the simple harmonic or sine wave which, when solely operative, produces the sensation of a pure, simple tone. The sounds used in speech do not, however, consist of simple tones, but of the simultaneous combination of a greater or less number of tones which are called partial tones, since they form the component parts of the sound. The three qualities which characterize sound are pitch, loudness and timbre or acoustic color — depending upon

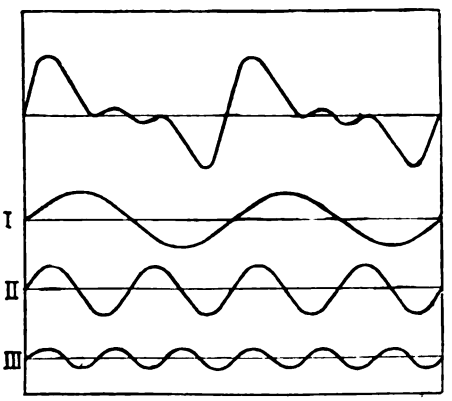

FIG. 2.

(1) The number of partial tones. (2) The pitch of the several partial tones. (3) The relative intensity of the partial tones. Phase need not be taken into account, as it is not perceived by the ear. Knowledge of the three qualities above named enables us, by means of the tuning fork, to produce the sound, and Helmholtz has artificially reproduced the vowels of human speech. Vowels are differently compounded for every pitch. The composition of the more important ones is shown in the table below.

According to the experiments of Lahr (Wiedeman Annal., 27, p. 94, 1886), the fundamental f' has 350 vibrations per second. For the sake of clearness, such partial tones only are given as are necessary to characterize the vowel. Those which are accidental and due to the inflections of the voice have been omitted.

Vowel.	$f = f^1$	$f' = f^2$	$c'' = f^3$	$f'' = f^4$	$a'' = f^5$	$c''' = f^6$	$d^{\sharp}_{'''} = f^7$	$f''' = f^8$	$g''' = f^9$
u	1	0.28	.....	.....	.....	.....	.....	.....	.....
ü	1	.....	.....	.....	.....	0.40	.....	.....	.....
i	1	.....	.....	.....	.....	.....	.....	0.19	.....
a	1	0.88	0.91	1.84	1.37	1.80	2.11	0.05	0.04
o	1	24.4	.....	22.8	.....	.....	.....	.....	.....
ä	1	.....	27.2	7.33	25.6	1.7	9.07	11.8	4.29
ö	1	.....	3.90	2.56	1.25	.....	.....	.....	.....
e	1	0.70	.....	.....	.....	.....	.....	1.15	2.11

The table shows that the partial tones coöperating in the formation of any vowel are the harmonic overtones of the respective fundamental tone, that is, tones of two, three and four times as many vibrations as the fundamental tone; in other words, the octave, twelfth, second octave, etc. This is the most important principle which has yet been discovered as to the formation of vowels. Furthermore, it may be said that every vowel is, in general, characterized —

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1. By the number;
2. By the intensity;
3. By the position

of the strengthened overtones with reference to the fundamental tone, and that overtones are relatively less high and less strong when the pitch is high than when it is low, but no law of exact general application to the formation of vowels has yet been worked out.

The composition of consonants is still wholly wrapped in darkness. It is a most difficult thing to fix the very complicated and abrupt curves of their vibrations, but to analyze them seems almost impossible. It may be said, generally, that the formation of vowels and their harmonic overtones is based upon a musical principle. On the other hand, the formation of consonants, with the irregular curves of their vibrations, is based upon a mechanical principle, i. e., upon a peculiar motion of the air which will not admit of simple analysis into harmonic vibrations. Vowels may be formed analytically by the combination of a few simple tones, whose numbers of vibrations increase in arithmetical progression — that is, are to each other as 1 : 2 : 3 : 4. Consonants are the combination of an infinite number of simple tones, between which no simple relations appear to exist.

If there is to be a complete correspondence between two sounds, their component parts — the partial tones — must exactly correspond in pitch and loudness. In the transmission of speech by telephone, it is not necessary that every sound be exactly reproduced. Intelligibility is not affected by a diminution in loudness. The essential thing is that acoustic color be preserved, so that a given vowel may always remain the same and, above all, that there be no change in the consonants. The principal requisite to this end is that the partial tones retain their relative intensity. The more exactly this condition is fulfilled the more perfect is the acoustic color, the timbre of the voice is preserved, so that we not only understand what is said, but readily recognize the voice of the speaker.

To make telephonic transmission an exact reproduction of speech, the forms of the curves of vibration must be preserved. The Bourseul and Reis telephones can not do this, because they transmute the harmonic vibrations of the air into intermittent current pulsations, the circuit being alternately opened and closed. They will transmit melody, transmission in such case depending only upon the pitch of the tones, but they can not be used to transmit speech, for which timbre is of prime importance. This is the characteristic point of difference between Bell's telephone and the instruments of his predecessors.

THE TELEPHONE.

1.— General Description.

The telephone in its simplest form, as constructed by Alexander Graham Bell, consists of a bar magnet, at one end of which is a piece of soft iron, wound with many turns of fine silk-covered copper wire, and in front of which is fastened a diaphragm of very thin sheet iron. The magnetism induced from the bar magnet behind it makes this diaphragm itself a magnet, and causes a mutual attraction between the diaphragm and the iron core more or less powerful according to the magnetic strength of the core. An electric current flowing thru the coil of wire will magnetize the iron core, the increase or decrease of magnetic force depending upon the direction of the current. If the current increases the magnetism, the diaphragm is more strongly attracted, and will slightly move toward the iron core. If the magnetism is decreased, the attraction of the diaphragm is likewise decreased, and it will move away from the core. A regularly and quickly pulsating current directed thru the coil of wire, supplied, for instance, by a tuning fork electromagnetically excited, will, as the circuit is closed and opened by the tuning fork, simultaneously increase and decrease the magnetism of the iron core, and therefore similarly affect the attraction and repulsion of the diaphragm. Thus the diaphragm is

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given a swinging motion, and will vibrate precisely as many times per second as the tuning fork, causing, therefore, the same tone to be heard.

The wire connecting the tuning fork with the telephone may be very long, and the mechanical force of the vibrations of the tuning fork may, in this way, be transmitted over almost any desired distance. Furthermore, the telephone is not confined to transmitting electric into acoustic vibrations. It will just as easily do the reverse, that is, transmute acoustic into electric vibrations. If, for instance, the diaphragm of the telephone, Fig. 3, be mechanically thrown into vibration by speech, the magnetic field in which lies the coil of wire *b* is changed. Inasmuch as the diaphragm itself is a magnet, the magnetic field will be strengthened or weakened as the diaphragm approaches or recedes from the iron core. These variations of the magnetic field generate in the coil surrounding the iron core induced currents, whose intensity exactly corresponds to the vibrations in the magnetic field and the vibrations of the diaphragm. The upper curve in Fig. 4 represents the motion of the diaphragm, while the lower curve shows the intensity, at the respective moments of time, of the induction currents produced, the intensity reaching the maximum when the diaphragm passes the point of equilibrium, and becoming zero when the displacement of the diaphragm is greatest, and it is changing the direction of the motion. When the diaphragm is at the point of greatest displacement, the direction of the current is reversed.

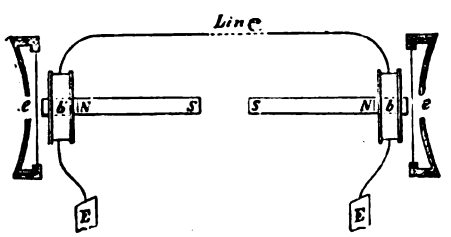

FIG. 3.

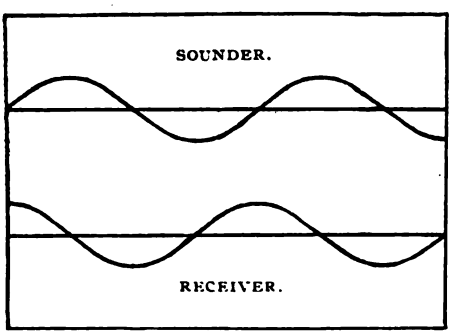

FIG. 4.

The wave current which the vibration of the diaphragm produces in the first telephone is conducted by the line to a second telephone, alternately strengthening and weakening the magnetism of the iron core of the latter, and, in consequence, strongly or feebly attracting the diaphragm, which will approach and recede from the iron core, reëxecuting the vibrations of the diaphragm of the first telephone. The two diaphragms do not, however, move precisely alike. The diaphragm of the second telephone, the receiver, will be nearest the iron core when the intensity of the current is greatest, which will be the instant the diaphragm of the first telephone, the transmitter, is most swiftly moving thru its point of equilibrium. For which reason the motion of one diaphragm is always a quarter of a wave length behind the motion of the other, as is shown in Fig. 4. But this does not affect transmission, as the ear, in its perception of sound, is independent of the phase of the motion.

Hitherto the simple harmonic wave corresponding to a pure tone has been the basis of our consideration, but all deductions thus arrived at will apply to any sound composed of simple tones. We can conceive it to be analyzed into its component parts, each of which will propagate itself wholly irrespectively of the others, and the method of speech transmission is thus made clear. The following seven successive phenomena may be distinguished:

1. Atmospheric sound waves strike the diaphragm of the telephone and cause it to vibrate.

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2. The vibrating diaphragm produces a change in the magnetic field of the telephone.

3. The changes in the magnetic field induce currents in the wire coil of telephone A.

4. The induced currents are transmitted from telephone A thru the line to telephone B.

5. In telephone B the induction currents produce changes of intensity in the magnetic field.

6. In consequence of these changes in the magnetic field the diaphragm of telephone B is thrown into vibration.

7. The vibrations of the diaphragm of telephone B give rise to air waves, which are propagated to the tympanum of the ear.

To secure complete telephonic transmission, the air waves of A and B must be similar to each other to such a degree, except in the matter of intensity, as to make precisely the same impression upon the ear. The two indispensable requisites for this are:

1. The vibrating motion of the air at both places must be separable into similar simple waves or partial tones at A. In consequence, these partial tones at A, which together form a certain sound, must arise simultaneously and be simultaneously reproduced by the diaphragm at B. If the higher partial tones were propagated more rapidly, they would be heard in B as encroaching upon the preceding sound, and would disturb it.

2. The amplitudes of the various simple ways must in both places bear the same relation to each other, that is, the amplitude of all waves at B must be smaller than those at A by the same constant factor. This factor depends upon the condition of the line and the efficiency of the telephone. These two requisites are essential for each of the seven above operations, Nos. 1 and 7 depend upon the mechanical condition of the diaphragm. Nos. 2 and 3 and Nos. 5 and 6 depend upon the magnetic field of the telephone, and No. 4 upon the electric properties of the line. We will discuss these three different subjects separately.

2.—The Diaphragm.

The external forces which affect the diaphragm are the sound vibrations of the air when the telephone is used as a transmitter, or the variations of the magnetic field when the telephone is used as a receiver. In both cases the vibrating motion of the diaphragm ought to correspond exactly to the actuating force.

When a diaphragm or any elastic body is thrown into vibration, its motion may be analyzed into two parts. The first part, the forced motion, being determined by the actuating force, the pitch of the vibration produced is, for this reason, the same as that of the actuating force. The second part of the motion, which may be called the free vibration, depends upon the mechanical properties of the diaphragm, and always appears when the diaphragm is subjected to a change of movement, due (1) to the application, or (2) to the withdrawal of an external force. In the former case the phenomena is called concomitant tones; in the latter, post vibrations.

By concomitant tones is meant that admixture of foreign sound which is audible in addition to the vibrations to be transmitted, and which consists of tones peculiar to the diaphragm, giving the entire volume of sound to be transmitted a characteristic accompanying sound and more or less impairing telephonic communication.

Post vibrations cause the tones peculiar to the diaphragm to be given out after the cessation of the actuating force; as a result, the successive sounds overlap and thus transmission is interfered with. Neither concomitant tones nor post vibrations ought to be plainly audible from a good telephone diaphragm. An essential characteristic of free vibration is its rapid diminution upon the cessation of the actuating impulse. Its energy is consumed and the vibrations are damped by a molecular friction and atmospheric resistance. This damping is the more consid-

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erable in telephone diaphragms, as they present to the air so large a surface in proportion to their volume. The diaphragm is, therefore, well adapted to infuse as the vibrating body, for it responds quickly to atmospheric sound vibrations and also damps its own harmful free motion. Indeed, Frolich has shown by experiments to be described further on that telephone diaphragms very accurately respond to the external actuating forces. To be sure, the free vibrations at least are still audible, as may be easily observed by using several telephones in succession. The metallic accompanying sound is at once distinctly detected and it will cause the transmitting voice to seem clearer when the diaphragm is highly elastic and has a high fundamental tone than when the diaphragm is less elastic and has a deep fundamental tone. Mercadier has shown experimentally that the peculiar tones of telephone diaphragms correspond to the higher tones of the human voice.

Voice distortion may be due to still another cause. It is not enough that diaphragm vibrations be of the same pitch as their actuating force, but, as the relative intensity of the separate partial tones must be preserved for the exact reproduction of tone volume, it is necessary that the range of vibration be always exactly proportional to the actuating force. But the law that in elastic bodies effect is proportional to force is true, as is well known, only for very small displacements. In case of greater displacements, the effect is much less in proportion to the force. A telephone diaphragm, for that reason, works more perfectly the smaller the amplitude of vibration. When the vibrations pass a certain point the amplitudes are no longer exactly in proportion to the actuating force, but the larger amplitudes, in general corresponding to the deeper tones, are reproduced relatively more feebly than the smaller ones, which in general correspond to the higher tones. Owing to the property of elasticity already mentioned, the relative loudness of the partial tones, and, in consequence, the acoustic color, are altered. Loud-speaking telephones may be constructed, but always at the cost of distinctness. Even vowel sounds seem to be distorted in them; a (ä) generally sounds like o, by reason of the suppression of overtones. As for the consonants, they are generally reproduced not at all, but the diaphragm gives us in their stead a buzzing noise.

Finally, inertia plays an important rôle. The greater the mass the greater must be the actuating force. In general, a telephone will be the more sensitive as the mass is smaller, or as the diaphragm is thinner. But in this direction there is a certain limit, determined by the properties of the magnetic field.

3.—The Magnetic Field.

The magnetic field is composed of two different elements, the one constant, and due to the steel magnet, the other variable and originating in the mutual influence of the magnetizing coil and the diaphragm. Heaviside has explained in a very simple way to what extent these two component elements contribute to the workings of the telephone. If the telephone be used as a receiver, and the intensity of the constant magnetic field produced by the permanent steel magnet be called m, and the intensity of the variable magnetism produced by the undulating electric current in the magnetizing spool be called M, then the intensity of the magnetic field resulting from both causes is $m + M$. The intensity of the magnetism induced in a diaphragm brought into this field amounts to $k\ (m + M)$, k signifying the magnetic induction constant. The force between magnet and diaphragm is proportional to the product of both magnetic moments, that is, proportional $t\ k\ (m + M)\ 2$. The change in this force due to the influence of the undulating current, and causing the vibration of the diaphragm, is $k\ (m + M)^2 - k\ m\ 2 = k\ (2\ m\ M + M2)$. When, as is usual, M is very small as compared with m, the actuating force F equals $2\ k\ m\ M$, and is thus proportional to the intensity of the permanent magnetism. The greater the intensity the more sensitive is the telephone. The permanent magnet not only very measurably increases the sensitiveness of a telephone, but it is also indispensable for reproduction, by diaphragm vibrations, of the electric waves flowing thru the magnetizing coils.

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To attain this, the permanent magnetic moment must be considerably greater than that corresponding to the largest of the waves to be transmitted. Fig. 5, by way of explanation, shows the varying conditions of the force between magnet and diaphragm in the three cases following, that is, in case —

1. When the permanent magnetic moment *m* equals zero.
2. When it is smaller than the variable magnetic moment.
3. When it is greater than the latter.

When *m* equals *o*, when *F* equals *k M* 2. The force between magnet and diaphragm never becomes negative, and the diaphragm is therefore never repelled, but always attracted, be the current flowing thru the magnetizing coil positive or negative in direction. When this current has the form of a harmonic wave the diaphragm will be attracted for every amplitude, whether positive or negative, and, as a consequence, the diaphragm will vibrate twice as often as the undulating current, as is shown in Fig. 5*c*, for which reason, in place of a tone to be transmitted, its octave will be reproduced.

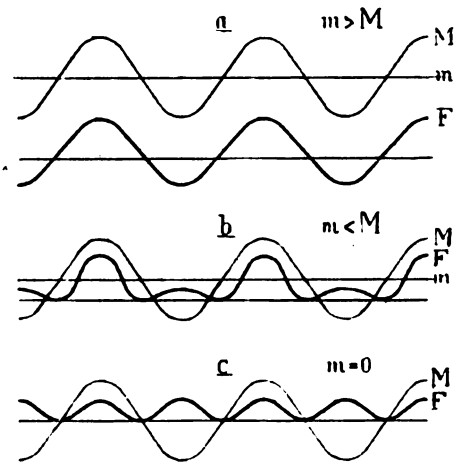

FIG. 5.

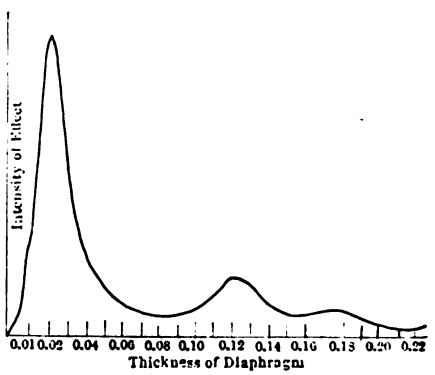

FIG. 6.

When, on the other hand, *m* is very much larger than *M*, then *F* equals 2 *k M m*. The influence of the factor *M* 2 has disappeared, and, together with the variable magnetic moment and the direction of the undulating current, the force now changes its sign. The diaphragm is alternately attracted and repelled and produces a tone which corresponds to the first tone in pitch (see Fig. 5*a*). When the permanent magnetic moment is not very large, the influence of the factor *M* 2 will prevent the diaphragm from vibrating symmetrically while regaining its equilibrium, attraction being much greater than repulsion. When the permanent magnetic moment is smaller than that due to the amplitude of the current waves, we have the vibration curve shown in Fig. 5*b* — the diaphragm is never repelled, but is always attracted, yet much more strongly for one than for the other impulse.

Thus the stronger the permanent magnetism the more sensitive the telephone, and, as a consequence, the more precise the reproduction of electrical vibrations by the diaphragm. In practice, however, a limit is soon reached beyond which there is no gain, but rather a loss in strengthening the permanent magnetism. The diaphragm may become permanently bent by the attraction of the permanent magnet, partly lose its elasticity and no longer swing symmetrically about its point of equilibrium. The telephone then becomes useless. This is a frequent source of trouble, but may often be remedied by reversing the diaphragm from time to time. Another limitation to the increase of permanent magnetism is the degree of mag-

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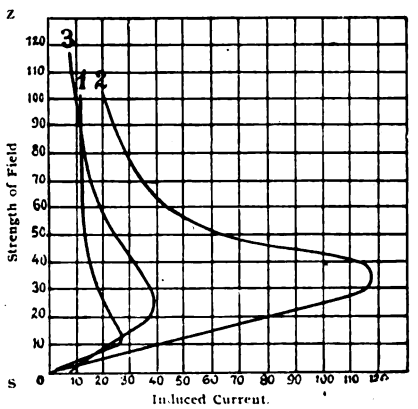
netization which the diaphragm will bear and remain sensitive. As soon as its magnetization approaches the point of saturation the rate of increase of magnetization becomes less and changes of attracting force have less effect. The telephone is no longer sensitive. This point of saturation is determined by the volume or the thickness of the diaphragm, so that a certain thickness of the latter is best adapted to each particular magnetic field, and conversely, for a diaphragm of a certain thickness there is a certain intensity of the magnetic field which will give the best results.

Mercadier established this mutual relation by experiment, working out the curve shown in Fig. 6. The abscissæ indicate the thickness of the diaphragms tested, varying from 0.148 to 2 mm. (6 to 80 mils). The ordinates represent the sensitiveness of the telephone on an arbitrary scale. A d'Arsonval telephone was used, a diaphragm of 0.2 mm. (8 mils) diameter giving the most satisfactory results. Thinner diaphragms are too quickly magnetized to the point of maximum saturation. Thicker diaphragms, on the other hand, are objectionable by reason of their stiffness, without compensation thru a proportionate increase of magnetic force. Besides the close dependence of sensitiveness in the telephone upon the thickness of the diaphragm, the curve shows a remarkable wave-formed increase and decrease of this sensitiveness as the thickness becomes greater, which may possibly be due to the method of experimentation. At any rate, no explanation of this peculiarity on principles of physics has yet been presented.



While Mercadier was investigating the relation between the intensity of the magnetic field and the sensitiveness of the telephone when used as a receiver, Professor Cross, of Boston, was presenting the same inquiry with the telephone used as a transmitter. He, too, finds that for every diaphragm there is a particular magnetic field which will enable it to attain its maximum of sensitiveness. Fig. 7 shows several of the curves worked out by him. Curve 1 was obtained with a diaphragm of ferrotype plate, curve 2 with a diaphragm of sheet iron, and curve 3 with one of hardened steel, their respective thicknesses being 0.25 mm. (10 mils), 0.61 mm. (24 mils), and 0.43 mm. (17 mils). The ordinates from *S* to *Z* show the intensity of the magnetic field, and the abscissæ the integrated values of the induced current on an arbitrary scale.

The diaphragms were caused to vibrate by the impact of a hammer, a force certainly much greater than that exerted by sound waves, and Professor Cross found, for that reason, an increase of sensitiveness with each increase of diaphragm thickness, a conclusion only constitutionally true, as demonstrated by the experiments of Mercadier, inasmuch as the strength of the actuating force is generally greater than when it is used as a receiver, for which reason transmitters have larger and thicker diaphragms. Steel is not well adapted for diaphragms, because,

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in a given magnetic field, the magnetic moment of steel is smaller than that of soft iron, which is given the necessary elasticity by being hammer-wrought.

4.—The Construction of the Telephone.

As a deduction from the foregoing observations, the following rules for construction may be laid down:

(a) *The Diaphragm.*—The material should be soft iron, on account of its magnetic properties. Telephone diaphragms may be made of other metals, such as aluminum or copper, but they are, as Mercadier has shown, several hundred times less effective, and the action is electrodynamic, not magnetic. The size of the diaphragm is determined by the nature of the sound waves to be transmitted. For powerful action it is well to make the diaphragm as large as possible. A diameter of 50 to 60 mm. (2 to 2.4 in.) has been found to be the best for receivers, and 80 to 90 mm. (3 to 3.5 in.) for transmitters.' Larger diaphragms are often used, but with no gain in efficiency, for the middle part alone is thrown into motion, while a large portion of the rim is unable to share the rapid vibrations by reason of its inertia. In order that, as far as possible, the entire diaphragm may participate in the movement, it must, up to a certain point, be elastic, but not so much so as to make the free vibrations too marked. For regular and uniform vibration, a diaphragm must be completely homogeneous, and the rim must be clamped firmly at every point, which is best accomplished by placing it between two well-turned metal rings. The ebonite cases in such general favor do not furnish adequate security in this regard, because ebonite in time undergoes internal changes and surfaces originally truly turned become warped. A thin layer of varnish will protect the diaphragm against rust; the layer must be as even and thin as possible, so that it may neither detract from the uniformity nor diminish the mobility of the diaphragm. It is well to varnish the outer surface only. Receiver diaphragms are usually 0.2 to 0.3 mm. (8 to 12 mils), transmitter diaphragms about 0.4 mm. (16 mils) thick, the thickness being determined by the intensity of the magnetic field.

The same telephone may be used both as receiver and transmitter, but in its construction it is well to regard the particular use to which the instrument is to be put. When used as a receiver, the actuating force comes from the undulating currents which circulate in the coils of wire and produce a change in the magnetic field. This force is very weak, owing to the low intensity of these currents, and to enable the diaphragm to vibrate as strongly as possible under their influence, it must be very mobile. It is for this reason that small, thin diaphragms are used in receivers. When used as a transmitter, the sound vibrations of the air actuate the telephone. The intensity of vibration in this case is given, but there is an unlimited volume of vibrating air at our disposal. According to an experiment by Siemens, the force of the air vibrations operating upon the transmitter is ten thousand times greater than that of the vibrations reproduced by the receiver. Even if this proportion be not generally true, it must certainly be conceded that the force acting upon the transmitter is always several hundred times greater than the energy reproduced by the receiver in the form of vibrations. Unfortunately, the greater part of this excess of force is not available for transmission, but is lost thru the damping effect of the elastic diaphragm. The low efficiency of telephonic transmission is thus attributable to the mechanical properties of the diaphragm. Diaphragms with less of the damping effect may be made, but in them the free vibrations become too marked, rendering transmission indistinct or impossible.

In the construction of the telephone, therefore, clearness and loudness are antagonistic. Clearness must always be the first consideration; loudness is desirable, but not absolutely necessary for intelligibility. The apparent advantage of using large diaphragms for the transmitter is modified by limitations beyond which an increase is rather a drawback than an advantage. When too large, diaphragms do not, owing to the inertia of their mass, follow the rapid vibrations of their air waves. Even with ordinary telephones, Professor Hagenbach

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observed a suppression of the high tones. A normal ear can perceive vibrations up to twenty thousand per second, but tones of such pitch are never perceptible thru the telephone, which ceases to be sensitive at about five thousand per second. The telephone fails to respond to more rapid vibrations, owing partly to mechanical inertia and partly, but in a less degree, to a retardation caused by the hysteresis of the iron. The greater the mass and inertia of the diaphragm become, the lower is the limit of its perceptible tones, and in addition, the tones become, of course, very faint long before their final extinction. Thru this process of weakening and ultimate complete suppression, the tone color is first distorted, the consonants then disappear entirely, and finally intelligibility ceases. The general observation is that large diaphragms, whether used in receivers or transmitters, cause the voice to seem muffled. The so-called "loud-speaking" telephones may be said to belong to the same category of physical problems as perpetual motion.

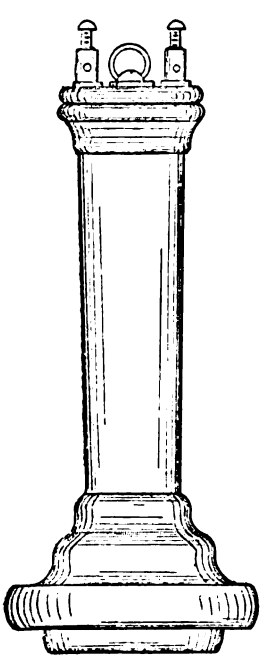

FIG. 8.

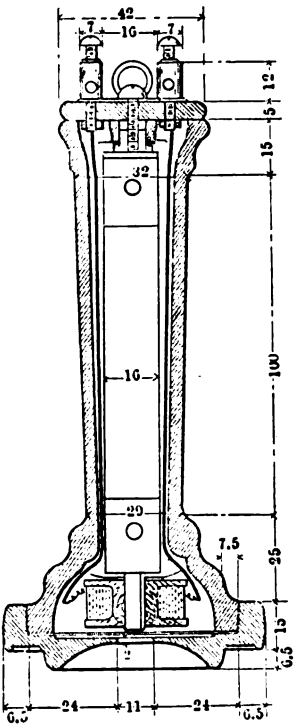

FIG. 9.

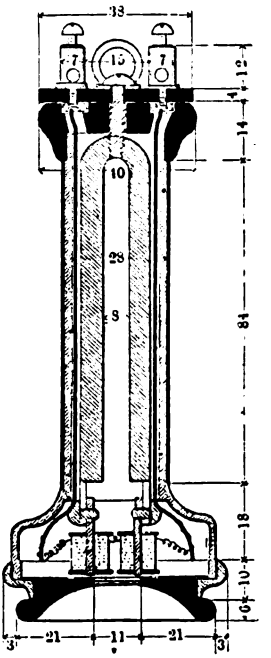

FIG. 10.

(b) *The Magnetic Field.*—The magnetic field must possess the proper degree of strength, and its character must be such as to bring as many lines of force as possible to the diaphragm, as well those due to the magnetizing coil, as those proceeding from the permanent magnet. The lines of force must rapidly change their direction and number, and the best conductor for them is soft iron, for which reason a piece of very soft iron, wound with insulated copper wire, is mounted upon the permanent magnet. The entire magnet system is brought as close as possible to the diaphragm, so that the diaphragm has just enough room to vibrate without being so strongly flexed by the magnetism as to stick to the poles (0.1-0.2 mm., 6 4-8 mils). The soft iron conducts to the diaphragm the lines of force, both of the permanent magnet and of the magnetizing coil. Provision must also be made to have the lines of force absorbed by the diaphragm, which can be attained to a satisfactory degree by rightly proportioning the thickness of the diaphragm,

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but all sorts of subsidiary means are employed, as we shall see when describing the various forms of telephones. The best results are obtained by placing opposite the diaphragm a horse-shoe magnet instead of a simple magnet, both poles being provided with soft iron cores wound with insulated copper wire. This will intensely magnetize the middle part of the diaphragm, a thing of the highest importance for the effectiveness of the instrument, the stronger or weaker magnetization of the rigidly clamped rim being of no consequence. In the double-pole telephones, these iron cores are not circular, but rather of a flattened elliptical form, thus uniformly magnetizing a larger part of the diaphragm and diminishing the magnetic resistance.

The form of the magnetizing coils is determined by the intensity of the electric waves, which is, on an average, from one-tenth to one-hundredth milliampere. Owing to this low intensity, only those layers of wire are effective which lie very near the iron core. Therefore, only very fine silk-covered copper wire 0.1 to 0.15 mm. (4 to 6 mils) in diameter is used, and the spool has a resistance of about 100 ohms. Larger spools are frequently used, but there is no gain in sensitiveness, because the outer layers are too far from the core. Frequently, too, the core is laminated, or is composed of a bundle of wires, presumably to avoid the Foucault currents, but a well-annealed core will follow the small magnetic oscillations without being divided. It is important, however, to have the core of the proper size, so that all available currents may be completely utilized. Its weight for ordinary purposes should be about 20 grams (⅔ ounce).

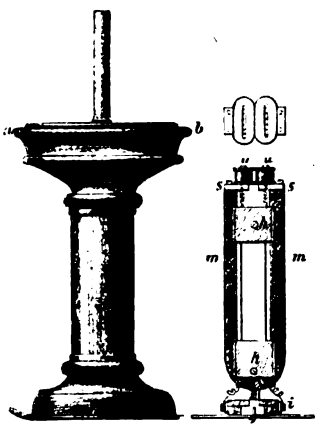

FIG. 11.

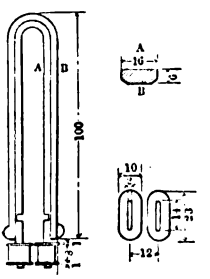

FIG. 10*a*.

After this recital of the principal points to be observed in the construction of the telephone, some descriptions of the several well-known forms of it will be proper.

Figs. 8 and 9 show the ordinary Bell telephone in its most usual form. This telephone is unipolar. The magnet consists of four flat strips of steel 115 mm. (4½ inches) in length, 16 mm. (⅝ inch) in width, and 3 mm. (⅛ inch) in thickness, which are screwed to the pole pieces, forming thus a single whole. The pole pieces are made of annealed iron, and each pole must be strong enough to lift a weight of 500 grams (1 pound). The pole piece opposite the diaphragm is a cylinder, around which are wound 1,415 turns of insulated copper wire 0.13 mm. (5 mils) in diameter, and of a resistance of 80 ohms. The magnet is fitted in an ebonite case, to the funnel-shaped opening of which the diaphragm is clamped tightly by a cover. To the coil of the electromagnet are soldered two insulated wires 1 mm. (40 mils) in diameter, which lead to the terminals mounted on the upper end of the case.

(*To be continued.*)

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TELEPHONE NEWS.

ARKANSAS.

PRESCOTT, ARK.—A Nevada county telephone system is being promoted by the citizens of Prescott. Some of the main points to be reached by the line are Laneburg, Rosston, Bodcaw, Willisville, Hutts, Sutton and Mount Moriah. Work on the new lines will begin at once under the superintendence of Mr. T. L. Bayne.

CALIFORNIA.

COURTLAND, CAL.— Freeport Telephone & Telegraph Company. Principal place of business, Courtland. Directors: William Johnson, T. W. Dean, W. J. Smith, G. B. Greene, P. G. Rhiel, L. D. Greene and H. F. Isham. Capital stock, $50,000; subscribed, $10,400.

LOS ANGELES, CAL.—Telephone lines are being extended to connect San Denis, La Verne and Lordsburg with the Pomona exchange.

DAKOTAS.

BISMARCK, N. D.—The Bismarck Telephone & Electric Company had articles of incorporation recorded in the office of the county clerk. Its object is to operate a telephone system and an electric railroad in Bismarck, N. D. The authorized capital stock is $100,000, divided into 1,000 shares of the par value of $100. Business will be begun with $20,000, which has been subscribed by these incorporators: Benjamin J. Fleuchaus, Newark, 195 shares; James Seme, Newark, three shares, and Edward Mancusi, two shares. The principal office in this State will be at 854 Broad street, where Frank B. Allen will act as legal agent.

ALEXANDRIA, S. D.—The Fairview Telephone Company, at Alexandria, with a capital stock of $2,000. Incorporators: F. A. Gregory, N. Van Tassel, William Newman.

FLORIDA.

BARTOW, FLA.—The Peninsular Telephone Company is erecting poles and says it is here to stay. So Bartow may have some exciting times in the telephone business before long.

ZOLFO, FLA.—There is talk of a telephone line from Crewsville to Zolfo, Florida. The length of the line will be fifteen miles.

GEORGIA.

CAMILLA, GA.—The Camilla Telephone Company, recently incorporated, has a capital stock of $10,000, and will install a system starting with forty subscribers.

DUBLIN, GA.—A. I. Smith has been granted franchise to establish telephone exchange.

GRIFFIN, GA.— Griffin, Georgia, is to have a new telephone concern known as the Griffin Telephone Company, and organized with the following officers: President, A. J. Burr; Vice-President, J. D. Boyd; Secretary and Treasurer, J. E. Drake; Superintendent, C. B. Thomas; Attorney, W. E. H. Searcy, Jr. Attorney Searcy will make application for a charter right away, and the order for supplies, etc., will be rushed off shortly.

ILLINOIS.

ATLANTA, ILL.—The Eminence Telephone Company, by H. E. Quisenberry, was granted permission to set poles along the highways in Atlanta and Eminence townships.

BELLEFLOWER, ILL.—Jacob Smith, of this place, is putting in an Independent telephone line at Belleflower.

CHICAGO, ILL.— R. C. P. Holmes, the purchasing agent of the Chicago Edison Company, met with an unfortunate accident on September 6 while riding on an Illinois Central suburban train. He was on the last car of the train, and while lighting a cigar fell off the platform, striking on his head and receiving a severe scalp wound. His collar bone and three of his ribs were also broken. Mr. Holmes' injuries will keep him confined to the house for at least a month. His many friends will wish for a speedy recovery.

CHICAGO, ILL.—The Independent Telephone Company is pushing vigorously the work of installing its plant, and announces that it will have 15,000 telephones in the downtown district by next spring.

ERIE, ILL.—The Farmers' Mutual Telephone Company has opened an exchange at Erie. Our Mutual lines can now be connected at Erie with the lines in that locality.

EL PASO, ILL.—The new Independent telephone company at El Paso is pushing matters along, and will have their new system up and in operation before cold weather sets in.

FARMER CITY, ILL.—The Farmer City Telephone Exchange has over 700 subscribers and takes over 700 miles of wire to operate it. There are forty toll stations.

FREEPORT, ILL.—A franchise has been granted to the Independent Telephone Company.

GALESBURG, ILL.—The underground work for the new telephone company at Galesburg has been completed. A total of 41,000 yards of conduit has been put in since July 1.

GALENA, ILL.—The contract for the construction of the new Independent telephone system was let to Jones & Winter, of Chicago. The construction cost is given as $133-610. E. L. Wortham, one of the promoters of the new company, stated that the system could be built to accommodate 4,000 subscribers. The switchboard and all apparatus

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installed will be on this basis. The contractors expect to get to work within thirty days and with favorable weather will have the Independent 'phones in operation by April 1, 1902.

HARDIN, ILL.—At a stockholders' meeting the Calhoun Telephone Company voted to increase its capital stock from $5,000 to $15,000. A proposition was also submitted to consolidate with the Pike County Telephone Company.

JERSEYVILLE, ILL.—The Calhoun County Telephone Company has increased its capital stock from $5,000 to $15,000. The company may consolidate with the Pike County Telephone Company.

LEWISTOWN, ILL.—Lewistown Automatic Telephone Company, Lewistown; capital stock, $2,000; operate a telephone system; incorporators, George F. Loar, Ralph Hanson, Lucien Gray.

MOLINE, ILL.—Col. W. S. Thomas and others seek franchises at Rock Island and Moline, Illinois, and Davenport, Iowa, and propose to establish Independent exchanges.

MAHOMET, ILL.—Coon Brothers, of Rantoul, are arranging to build a telephone exchange at Mahomet.

NEOGA, ILL.—Neoga Telephone & Telegraph Company, Neoga; capital stock, $2,500; operate telephone and telegraph line; incorporators: A. J. Baughman, Daisy Baughman, Mamie A. Sheehan.

OHIO, ILL.—The Bureau County Independent Telephone Company has issued $50,000 more capital stock.

PEKIN, ILL.—The new telephone company has a large force of men at work digging trenches for the laying of their wires underground. The work will be pushed with all possible haste in order that the work may be completed before the cold weather arrives. The Kellogg Switchboard & Supply Company has been awarded the contract for the switchboard and 350 instruments to be put in for the Citizens' Telephone Company, of Pekin, at a cost of $7,500.

POLO, ILL.—The officers of the Ogle County Telephone Company and the Independent County Telephone Company, of Polo, met in Rochelle, on Thursday evening, September 12, and voted to consolidate the two companies. The new company will be known as the Ogle County Telephone Company. Horatio Wales, of Polo, was elected president; G. W. Hamlin, of Rochelle, was elected vice-president; A. W. Guest, of Rochelle, was elected secretary, and A. B. Sheadle, of Rochelle, was elected treasurer. The directors are: H. Wales, G. W. Hamlin, A. W. Guest, A. B. Sheadle, B. W. McHenry, Emanuel Hilb, George O'Brien, John Delaney and A. A. Phelp.

PRINCETON, ILL.—The Bureau County Independent Telephone Company now has 370 telephones in operation in Princeton. This is an increase of fifteen in the last month.

ROCKFORD, ILL.—The Rockford Home Telephone Company has been granted a charter, with capital stock of $200,000; incorporators, George F. Wilson, Frank M. Puffer and George Miner.

ROCK ISLAND, ILL.—Bills & Wortham are going to renew their application for a franchise at this place to construct and operate an Independent telephone exchange.

STERLING, ILL.—The Whiteside County Telephone Company will make extensive improvements in Morrison and Sterling.

STERLING, ILL.—H. H. Evans, of Aurora, is president of the newly organized Whiteside County Telephone Company which has secured a twenty-year franchise at Sterling.

STREATOR, ILL.—At a meeting of the stockholders of the Independent Telephone Company, the following officers were elected for the ensuing year: President, Alfred Stromberg, of Chicago; Vice-President, Henry Shafer, of Chicago; Secretary, P. J. Lucey, of Streator; Treasurer, Charles W. Steiger, of Chicago. These officers, with T. F. Murphy, of this city, comprise the board of directors. The company was originally incorporated for $40,000, but this will be increased at once to $75,000. The plant here has already cost $60,000. The principal stock of the company is owned by the Stromberg-Carlson Manufacturing Company, of Chicago.

WOODSTOCK, ILL.—Woodstock Exchange & Telephone Company; capital stock, $20,000. Incorporators: Charles H. Donnelly, George W. Field and others.

IOWA.

ALBIA, IOWA.—The local exchange at Albia, Iowa, has been sold to Dr. S. M. King, J. S. Moon and G. M. Heiserman, who will incorporate and extend the system all over the county.

BRIGHTON, IOWA.—The Livingston County Telephone Company has been granted a franchise by the village council of Brighton. This is the new Independent company, organized to compete with the Bell Company in Livingston county.

BONAPARTE, IOWA.—A telephone line between Big Mount and Bonaparte is being constructed.

BRITT, IOWA.—Amended articles for the Greene & Western Telephone Company, of Britt, of which Thomas A. Way is president, increasing capital stock to $150,000.

CLEARFIELD, IOWA.—The Lenox & Clearfield Telephone Company has been formed at Clearfield, Iowa, with a capital stock of $15,000.

CEDAR RAPIDS, IOWA.—The National Telephone Company, of Cedar Rapids, Iowa, has been incorporated, with a capital stock of $15,000.

DALLAS CENTER, IOWA.—The Farmers' Telephone Exchange, with central office in this town, is now in operation. About seventy-five farmers and most of the business places in town have joined the exchange. Three new business blocks are under way of construction to replace the ones destroyed by the big fire on the Fourth of July. They are being built by Grant McLean, John Lloyd and T. W. Ferguson, respectively.

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DES MOINES, IOWA.—The Southern Iowa Telephone Company, of Des Moines, Iowa, has been incorporated, with $60,000 capital stock, to take over a system of toll lines connecting with Indianola, Winterset, Osceola, Mount Ayr and other points. The new company will improve the lines and may install local exchanges in some of the towns.

DUBUQUE, IOWA.—The Standard Telephone Company gives notice that on and after October 1 a change in toll rates will be made as follows: Within the county, 15 cents; to Dubuque and all other outside points, 25 cents.

DUBUQUE, IOWA.—The Tri-State Telephone Company has filed articles of incorporation with the county clerk of Dubuque, Iowa. The capital stock is $100,000. This is a Waukon institution, the men interested representing the Standard Telephone Companv. This means that the Standard will be extended into Wisconsin and Illinois. The officers of the new telephone company are: President, Vic H. Stevens; Vice-President. E. L. Cass; Secretary and Treasurer, C. H. Sandbeck. These, with Messrs. J. H. Denfihoff, J. W. Blessing and F. A. Irish, are directors and also incorporators.

FONTANELLE, IOWA.—The Hawkeye Telephone Company will complete their line to Fontanelle and have the line open for business at once. Mr. Bandy informs us that the line will connect at Fontanelle with some other line, but that it is not yet settled what line it will be.

LOST NATION, IOWA.—The Lost Nation & Keystone Telephone Company has filed articles from Lost Nation, Iowa, with a capital stock of $1,000.

SILVER CITY, IOWA.—The Tabor Telephone Company has notified its patrons that they will be entitled to talk free to all parts of Mills county. Heretofore an extra fee of 15 cents has been charged for use of the line outside of this circuit. The telephone company is making every effort to give the patrons their money's worth, and the present movement should place many new 'phones in every town in the county.

SIOUX CITY, IOWA.—F. B. Rowe, of the Black Hills Telephone Company, seeks a franchise in Sioux City, Iowa, for his line. He says that he is now backed by sufficient capital to carry out the original intention for a system of long-distance connections thru the cattle country. He asks that a special election be called to vote on his petition for a franchise.

WAVERLY, IOWA.—The Waverly Telephone System, of this place, has just finished laying about 1,500 feet of underground circuit. New switchboards are being put in which will accommodate about 400 patrons, and other improvements are being made. All work will be completed in a short time. The telephone exchange here now known as the Waverly Telephone System was, until recently, operated by the Cedar Valley Telephone Company, which sold the exchange to a local company organized here. Half the stock in the new organization is taken by the Cedar Valley Telephone Company, the rest by citizens of this city. The capital of the new company is $30,000.

YORKTOWN, IOWA.—A new rural telephone line is now being constructed from this city to Page Center, and it will extend from here to Yorktown. The first steps have also been taken to extend the line just opened from this city to Shambaugh on to College Springs and from there to Blanchard. The county will soon be covered with these Independent telephone lines in all directions, and then it will be possible for the farmers to talk with distant and remote friends in all parts of the county and bring them together as close neighbors without any trouble or additional expense, as a mutual exchange exists between the stockholders on each line and no extra charge is made to them for talking to friends on any of the lines.

INDIANA.

BLUFFTON, IND.—The United Telephone Company, of this city, and the Indiana Telephone Company, of Hartford Citv, have been consolidated. The company now controls the exchanges at Marion, Huntington, Portland, Bluffton, Hartford City, Geneva and Upland. It has 2,100 'phones in use, 727 miles of toll line, and thirty-five toll stations. The capitalization of the new company will be $300,000, and it will be known as the United Telephone Company.

EEL RIVER, IND.—The Eel River Telephone Company have filed articles of incorporation showing a capital stock of $10,000. The directors of the company are: Aaron A. Ulrey, Benjamin Oppenheim, Lewis Signs, Dayton C. Harter and Jesse J. Tyler. The company will operate telephone lines and exchanges in Wabash, Whitlev Huntington, Kosciusko, Miami and Fulton. Its main office will be located at North Manchester, Wabash county.

FRANKLIN, IND.—Great excitement prevails here over the controversy between the Central Union and Independent telephone companies. Originally the Central Union was given a franchise to operate a telephone exchange in this city, but after establishing a plant it was removed elsewhere, and this territory was abandoned, as claimed by its opponents. An Independent company was recently given a franchise, thereupon the Central Union attempted to establish another exchange here, but the council revoked its franchise and ordered the city marshal to arrest any person attempting to erect poles. Undaunted, the Central Union put linesmen to work, but all were arrested on the charge of trespass and obstructing the streets.

GLEN HALL, IND.—The Odell Telephone Company has elected S. B. Lutz, president; H. G. Lutz, secretary and treasurer, and W. B. Foresman, manager. The company, whose incorporation was recently noted, purchased from the receiver the Shawnee-Mound system, which has been in operation for six years. In one of the exchanges a Sterling

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board is used and in the other an American board, of 70 and 50 drops, respectively. The line will be practically entirely reconstructed, and a toll line between Lafayette and Attica will be strung on the new poles. Most all of the company's subscribers, of which it has 187, are farmers.

MORGANTOWN, IND.—The Morgantown Telephone Company: capital stock, $10,000; directors: A. M. Fleener, E. M. Woods and H. J. Griffith.

MUNCIE, IND.—An Independent telephone system will probably be established in Albany by F. A. Lundquist, of Chicago, who says he has an automatic device that will do away with operators, the subscribers making their own connections.

NEW POINT, IND.—The Decatur County Independent Telephone Company, of Indiana, has increased its capital stock to $20,000, all of which has been paid in. The company now has over $150,000 of pole lines in the country, and is extending its line from Milhausen, New Point and Westport.

ORLEANS, IND.—The Hoosier Telephone franchise granted bv the town of Mitchell will probably be transferred to the Georgia Telephone Company, who will erect and connect with the Hoosier at Orleans, an exchange in Mitchell. This will grant to the citizens of Mitchell the privilege of communicating with any point touched by the Hoosier system.

PRINCETON, IND.—H. J. Kusel, of Chicago, and Charles F. Stephens have secured a fifty-year franchise to build and operate a telephone exchange at Princeton.

RICHLAND, IND.—The Coöperative Telephone Company's lines to Richland and Williamstown will soon be completed.

TELL CITY, IND.—Manager John Backer will extend his telephone lines to Tell City soon.

WHEELING, IND.—Wheeling Telephone Company; capital stock. $1,500. Directors: Elmer E. Boone, I. Newton Brown and others.

KENTUCKY.

FALMOUTH, KY.—The Owenton & Williamstown Telephone Company has completed its line from Falmouth to Boyd, which gives Falmouth telephone connection with all the towns of central Kentucky.

FRANKFORT, KY.—The Jessamine Home Telephone Company; capital increased from $10,000 to $20,000.

LOUISVILLE, KY.—The Independent Long-Distance Telephone & Telegraph Company, with a capital stock of $1,000,000, has been organized here to build a line connecting the Home Telegraph Company and the Independent Company, of Louisville.

KANSAS.

BURNS, KAN.—Peabody now has telephone connection with Burns.

TOPEKA, KAN.—The Independent Telephone Company, of Topeka, Kan., is installing central-energy switchboards and equipment, and full metallic and copper circuits.

MINNESOTA.

ADAMS, MINN.—The Le Roy Telephone Company now has its line between this place and Taopi and Adams in full operation.

CENTERVILLE, MINN.—Extensive improvements are being made on the telephone system at Centerville.

DULUTH, MINN.—The Northland Telephone Company filed articles of incorporation, with a capital stock of $25,000. The company is related to the Zenith Telephone Company, and will be its long-distance associate, making connections with many of the principal towns in northern Wisconsin and Minnesota. It will give another long-distance system between Duluth and the ranges, and it will run to Cloquet and Carlton. It also intends to connect with the Consolidated Telephone & Telegraph Company in the Twin Cities. The incorporators are Charles C. Kritzer, V. Carlson, H. A. Allen, A. E. Webster and M. Mecalson, all of Duluth. The officers are as follows: President, C. C. Kritzer; Vice-President, A. E. Webster; Secretary and Treasurer, H. A. Allen.

FAIRMONT, MINN.—The Northwestern Telephone Exchange Company is putting thru another circuit from the Twin Cities to Mankato, Winnebago City and Fairmont, Minn.

MORRIS, MINN.—The Stevens County Telephone Company, of Morris, filed articles of incorporation with the secretary of state. The incorporators are: C. R. C. Johnson, H. L. Hulbert, George F. Darling and George F. Darlicy, of Morris. The company has a capital stock of $10,000.

MINNEAPOLIS, MINN.—One of the most peculiar freaks of a recent storm which caused so much damage in Minneapolis, Minnesota, was a telephone there that had been out of order for some days. Immediately after the storm it worked like a charm, and it is now in good order.

PRESTON, MINN.—The stringing of wires for the new telephone exchange has commenced. The central office will be in the second story of the Weiser block.

ROCHESTER, MINN.—The new telephone line is being started thru here from Rochester, which will be much appreciated by the farmers when done. The poles are on the ground.

ST. PAUL, MINN.—The Northwestern Telephone Exchange Company, of St. Paul, recently secured a restraining order to prevent the city engineer from cutting down certain poles of the company. The city engineer announced that the poles must be removed from the underground district by a certain date or they would be cut down. The company claims that it has not been able to secure certain materials and also that the order of the council to remove the poles was arbitrary.

TRUMAN, MINN.—The Armstrong Telephone Exchange Company. of Truman, filed articles of incorporation with the secretary of state. Its capital stock is $25,000.

TWO HARBORS, MINN.—Mr. Thomas Owens is no longer owner of the telephone fran-

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chise which was granted him by the council of the village about a year ago. The franchise, together with all the privileges accruing to him thereunder, has been assigned to the Duluth & Iron Range Railroad Company.

VIOLA, MINN.—The Viola Telephone Company has been incorporated, with a capital stock of $10,000.

WASECA, MINN.—A new switchboard of three hundred connections has been placed in the exchange at Waseca, Minnesota.

WEST CONCORD, MINN.— O. G. Graham, of Pine Island, Minnesota, proposes to establish a local system for West Concord, Minnesota.

MAINE.

PORTLAND, ME.—The Dirigo Telephone Company was granted licenses for lines to connect Rangeley, Farmington, Livermore Falls, thence thru the central section of Western Main down to the Portland exchange. It has invested from $30,000 to $40,000 in Portland during the past year, and will expend from $150,000 to $200,000 more in the extension and completion of its system. Mr. L. A. Goudy is president and general manager of the company.

SKOWHEGAN, ME.—The Somerset Traction Company is putting in a private telephone line between Madison and this place.

SOUTH PARIS, ME.—The Sumner & Paris Telephone & Telegraph Company has been organized, with A. E. Dean president.

MISSOURI.

CLINTON, MO.— Mutual United Telephone Company, of Clinton; capital stock, $15,000. Incorporators: G. R. Lingle, S. T. Neill, W. F. Hall and others.

HARDIN, MO.—The Calhoun Telephone Company, of Hardin, Missouri, has increased its capital stock from $5,000 to $15,000.

KANSAS CITY, MO.—An ordinance granting a franchise to an Independent telephone company at Kansas City is pending before the City Council of that city.

KANSAS CITY, MO.—Winfield Telephone Company; capital stock, $25,000; incorporators, L. P. Smith, R. B. Montague and others.

PLATTSBURG, MO.—Telephone connection was established between Plattsburg and Grayson. Many farmers between the two points will avail themselves of this mode of communication.

ST. JOSEPH, MO.— Manager A. P. Fair, of the Nebraska Telephone Company, in this city, has been promoted to the management of the company's interests at Council Bluffs, and will leave about October 1 to enter upon his duties as such. He will be succeeded here temporarily by Mr. Patmore, of Lincoln.

ST. LOUIS, MO.—The Police Telephone & Signal Company, of St. Louis; capital stock, $50,000. Incorporated by Henry A. Baker, Elisha Morgan, Eugene Buder and others.

MASSACHUSETTS.

LOWELL, MASS.—A $20,000 attachment was filed in the registry of deeds in Salem against James Thorpe, of Lowell, and Herbert L. Sprague, of Salem, in an action of tort or contract by the Wisconsin Telephone Company, and another exactly similar by the Michigan Telephone Company; also an attachment in $40,000 by the Southwestern Telegraph & Telephone Company, of New York, three Lowell national banks being specially attached as trustees of the parties.

NEW BEDFORD, MASS.—The Fall River Automatic Telephone Company has commenced operating its exchange with a portion of its subscribers, and is adding to the number as fast as telephones can be put in and connected by the present gang. New applications for the automatic service are coming in freely on account of the satisfaction given. The Strowger Automatic Telephone System is used, the same system as that installed in New Bedford some months ago, but with important improvements.

TAUNTON, MASS.—Work is progressing rapidly on the conduits which are to put the telephone wires beneath the surface.

WARSAW, MASS.—Warsaw is to have telephone competition. The Independent company is erecting poles and will soon install instruments in that village.

WEST MILLBURY, MASS.— Millbury will have a telephone exchange. This fact is settled for a certainty. L. S. Black, of Boston, who has been working up the exchange question, has enough subscribers to insure the placing in position and operation of an exchange. Mr. Black states that to make the affair an absolute certainty five more subscribers ought to be secured. This remaining number, no doubt, will be easy to obtain, as there are many who want a telephone but have not as yet made their wishes known.

MICHIGAN.

DETROIT, MICH.— Mr. S. P. Grave, formerly engineer of the Erie Telephone System at Detroit, Michigan, resigned to accept the position of general superintendent of the Beaumont Telephone Company, Beaumont, Texas. This company is building an up-to-date plant of 1,200 capacity central energy copper metallic circuits and underground conduits in the business section. They also thoroly cover the oil fields and surrounding territory with toll lines.

DETROIT, MICH.—Work has been resumed on the new building to be erected by the People's Telephone Company, of Detroit, Michigan. The structure, when completed, will cost about $225,000.

DETROIT, MICH.—The Wyandotte council has granted a thirty-year franchise to the People's Telephone Company.

KIBBIE, MICH.—The Kibbie Telephone Company has added much to the appearance of their lines about here by the use of fine cedar poles mounted with cross-arms.

SAGINAW, MICH.—The Crown Point telephone people are waiting for poles on their new line between here and Merrillville. The poles are shipped from Saginaw, Michigan.

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NEW YORK.

ALBANY, N. Y.— Ouleout Valley Telephone Company. To operate in Delaware county. Capital stock, $3,000. Directors: F. B. Smith, E. A. Mackey and E. T. Edgerton, of Franklin.

ALBANY, N. Y.—The New York State Telephone Company was incorporated, with a capital stock of $2,500,000, to operate in the city of Buffalo. The directors are: William D. Barnard, of St. Davids, Pennsylvania; Henry M. Shafer, of Chicago; William F. Mackey, of Buffalo; Richard G. Park, of Westchester, Pennsylvania; C. M. Clement, of Sunbury, Pennsylvania; Edward Davis, of Philadelphia, and Ward R. Bliss, of Chester, Pennsylvania.

ALLEN'S HILL, N. Y.—A branch of the People's Telephone Company's line has recently been extended to Allen's Hill, New York. The branch to Richmond Mills has been changed so as to connect without intermediate switching with Honeoye, New York. Some forty 'phones are now in touch with the line between Vincent and Hemlock.

FORT EDWARD, N. Y.—The new Independent telephone company has strung cables thruout this village.

NEW YORK, N. Y.—There seems to be no doubt that Mr. Charles W. Morse, of this city, is now the owner of a controlling interest in the stock of the Telephone, Telegraph & Cable Company of America. This ownership places in Mr. Morse's hands the Independent telephone properties of the Knickerbocker Telephone Company, of New York, the Massachusetts Telephone Company, of Boston, the Boston & New York Telephone Company and several smaller independent telephone companies in the West — property, as undeveloped, of the value of at least $1,000,000; also 21,000 shares of the stock of the Erie Telegraph & Telephone Company, to which can be added Mr. Morse's purchase of 30,000 shares, thereby giving him 51,000 shares out of a total of 100,000 shares issued by the Erie Company.

TOWLESVILLE, N. Y.—The extension of the Kanona & Towlesville, New York, telephone line to Howard, is being agitated.

TROY, N. Y.—The Rensselaer Telephone & Telegraph Company, of Troy, filed with the secretary of state a certificate of increase of capital stock from $150,000 to $300,000. The amount of capital of the company actually paid in is $2,600, and the certificate states that there are no debts or liabilities against the company. The certificate is signed by Charles Mahoney and Thomas J. Mooney.

WORCESTER, N. Y.—There is a widespread desire for a telephone line from Worcester to South Worcester, New York.

NEW JERSEY.

BURLINGTON, N. J.—The Standard Telephone Company has been granted a franchise by the city council of Burlington, New Jersey.

ELIZABETH, N. J.—The Elizabeth Telephone Company, which was organized six years ago, has been sold to Barker Gummere, of Trenton, and J. L. Hammell, president of the Trenton Trust Company, who, it is understood, are interested in the Interstate Telephone Company.

JERSEY CITY N. J.—The Eastern Massachusetts Telephone & Telegraph Company, Jersey City, New Jersey. Capital stock, $25,000,000. Incorporators: Albert E. Bailey, Almon E. Carpenter and Washington Lithgow, all of 15 Exchange place, Jersey City.

TRENTON, N. J.— Chancellor Magie made an order for the sale of all property of the Home Telephone Company, of Trenton, in the foreclosure proceedings instituted by the Morton Trust Company, of New York. The telephone company was recently absorbed by the Interstate Telephone Company, which will be the purchaser. The trust company holds as trustee three hundred $500 bonds of the telephone company.

NEW HAMPSHIRE.

KEENE, N. H.—The New England Telephone Company is making arrangements to put in a new switchboard at the Keene exchange and add a chief operator to supervise the service. The board will be of the latest type of manufacture, and Manager Rice expects to get it ready for use this fall.

OHIO.

AKRON, OHIO.— C. F. Ames, of Akron, will manufacture a recently invented device for use in connection with telephone transmitters. It consists of a hard rubber tube so corrugated that it tends to overcome the imperfections sometimes noticed in talking over a telephone. It is claimed that it neutralizes any echo.

BARNESVILLE, OHIO.—The lines of the Belmont Telephone Company have been connected with Barnesville, and the local exchange there is being installed.

CLEVELAND, OHIO.—The Frontier Telephone Company was incorporated, with a capital stock of $500,000, to connect by telephone from a central exchange in Buffalo, New York and the intervening points, and Cleveland, Ohio.

CINCINNATI, OHIO.—The Cincinnati Telephone Company. Capital stock, $10,000. Incorporators: Peter Nodler, Joseph H. Becker and others.

COLUMBUS, OHIO.—The Cridersville Telephone Company, of Auglaize county, has been incorporated, with a capital stock of $5,000.

CRIDERSVILLE, OHIO.—The Cridersville Telephone Company, Auglaize county, capital stock $5,000, was incorporated by Jacob Hauss, J. W. Musser, W. N. Bowsher and others.

JACKSON, OHIO.—The stockholders of the Home Telephone Company have increased the capital stock to $75,000.

JEFFERSONVILLE, OHIO.—The Citizens' Telephone Company has all the poles up on the

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Cedarville-Jamestown line. Poles are set on the Paullin road as far as Gundy Paullin's and this line will be run on into Grape Grove, where a good list of subscribers has been secured. Workmen started on the line to Jeffersonville. The wire for these lines is expected daily and connections will be made as soon as it arrives.

LEWISBURG, OHIO.—The Lewisburg Telephone Company, of Preble county, has increased its capital stock from $1,500 to $10,000.

MILTON, OHIO.—The Progress Telephone Company has purchased the Garland line.

PORTSMOUTH, OHIO.—In less than one year the Portsmouth Telephone Company has increased its subscription list from 500 to 750, which is 300 more than the Bell Company ever had. The company is preparing to build a number of rural lines, and expects to cover the whole of Scioto county. The demand for farmers' telephones is increasing faster than it can be taken care of. F. B. Finney is president of the Portsmouth Telephone Company.

TOLEDO, OHIO.—Citv Engineer Tonson has granted a permit to the Toledo, Ohio, Home Telephone Company to excavate and lay a conduit for its wires in certain streets of that city.

TOLEDO, OHIO.—Investors are being offered bonds of the new Home Telephone Company. It is said that the company will be capitalized at $2,500,000, and that the actual cost to the stockholders will be $650,000. Bonds are to be issued to the amount of the actual cost, and these are offered as follows: For $100 in cash the promoters offer $115 in bonds and $115 in stock. It is claimed that the men actually behind the Home Telephone Company are Brailey & Barber, of Wauseon, and Parks Foster, of Elyria. They claim to have 4,000 contracts for 'phones already on their books. Some one has counted the names in the new book of the Bell Company and says there are but 2,160 there. If the Home has 4,000 customers, at $24 per year, this means an income of $100,000 a year to start off.

TROY, OHIO.—The Home Telephone Company is considering the matter of extending its line thruout this vicinity.

OKLAHOMA TERRITORY.

FORT GIBSON, O. T.—The council has granted a franchise to Stapler & Hicks, of Tahlequah, to erect and maintain a telephone system in Fort Gibson for twenty years, five per cent of the proceeds to go to the town.

GUTHRIE, O. T.—The Kiowa Telephone Company has been issued a charter by Secretary Grimes, with a capital stock of $25,000. It is to exist for a term of twenty years, and its directors are: J. R. Edder, of Eldon, Iowa; W. D. Davis, of Pulaski, Iowa, and J. P. Evans, of Hobart, Oklahoma. The offices of the company are to be at Hobart.

HENNESSEY, O. T.—The Central Oklahoma Telephone Company has increased its capital stock from $10,000 to $20,000. Hennessey is the headquarters of this company.

PENNSYLVANIA.

CHESTER, PA.—The Independent Telegraph & Telephone Company, of Delaware county, will ask Chester city councils for the privilege of putting its wires underground.

ERIE, PA.—News received from Erie, Pennsylvania, states that at a recent meeting of the stockholders of the Mutual Telephone Company, a proposition to increase the bonded indebtedness of the company from $50,000 to $75,000 was voted upon and carried without dissent. The $25,000 realized on the bonds is for the purpose of canceling a floating debt of that amount, contracted by the recent extension of the company's lines and the purchase of additional equipment. The statement of Manager John Z. Miller to the directors shows that the affairs of the company are in an excellent condition. The number of its subscribers is being increased continually. W. B. Trask is president of the Mutual Telephone Company and George Burton is secretary and treasurer.

ELIZABETH, PA.—The Federal Telephone Company has been having a great deal of trouble in extending its lines in its Monongahela and Youghiogheny valleys by a strike of linemen. The work was completely at a standstill for a time, but other men have now been secured and the work of extension goes on.

ELIZABETH, PA.—It is reported that the Interstate Telephone Company has acquired the Elizabeth Telephone Company. It is understood the purchase price was $40,000.

HANOVER, PA.—Hanover, Pennsylvania, parties have bought controlling interest in the Maryland Telephone Company and will extend the lines to Martinsburg and Shepherdstown, also into Virginia and Pennsylvania. John K. B. Keiffer, of Hanover, Pennsylvania, has been elected secretary.

MANSFIELD, PA.—The Citizens' Mutual Telephone & Telegraph Company, capital stock $1,000, has been incorporated.

PHILADELPHIA, PA.—Soon after the Keystone Telephone Company had been given its valuable franchises there was a rumor that the franchises were to be sold. This was denied by a stockholder, who remarked, incidentally, that the franchises were worth $50,000,000, and would not be sold for less. Whether this is a correct estimate we do not know, but the franchises are certainly of great value, especially if the company is to be relieved of the necessity of properly repaving the hundreds of miles of streets that are to be torn up for its conduits. Unfortunately, there is no public official to whom an appeal can be made for an enforcement of the law on the subject.

PENNSBURG, PA.—The Perkiomen Telephone Company has received the right to erect poles and to string wires thru Pennsburg and East Greenville.

UNIONTOWN, PA.—The Farmers' telephone line from Greensboro to Davidson and

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branches have been sold at this place by the sheriff.

WASHINGTON, PA.—The stockholders of the West Penn Telephone Company, of Washington, Pennsylvania, have increased the capital stock of the company from $12,000 to $50,000. With the additional financial resources the company expects to gain entrance into the town of Washington, a right which has hitherto been denied.

SOUTH CAROLINA.

SPARTANBURG, S. C.—The Home Telephone people are making great improvements in their system here. Hundreds of large cedar posts are being put in and a metallic line to Spartanburg.

TEXAS.

BEAUMONT, TEX.—The Beaumont Telephone Company began excavating for the underground conduit on Crockett street, and the construction of the new telephone system is inaugurated. The work will be pushed as rapidly as possible and no delays are contemplated except perchance those which may be caused by circumstances over which the management has no control. The underground conduits will be used thruout the business section, covering a distance of about one mile in the central portion of the city.

DAWSON, TEX.—Dawson has an Independent telephone exchange which has in use thirty-five 'phones and will put up more as demanded.

DENTON, TEX.—J. D. Carmichael has purchased the Denton, Texas, Telephone Exchange at a price above $10,000 from S. W. McClure.

GAINESVILLE, TEX.—The Southwestern Telephone Company will grant the request of the Red River Telephone Company and give a connection in Gainesville. This will give the people of this city the opportunity of talking with the merchants and rich farmers of that part of the territory lying adjacent to Burneyville, Leon and other good towns.

GREENVILLE, TEX.—J. T. Young, J. G. Gordon and Messrs. Thompson, of Cooper, have been granted a franchise for an Independent telephone company in this city.

PARIS, TEX.—It is said that a member of the telephone company to which the city council granted a franchise several months ago on condition that it would file a bond in the sum of $1,000 for the faithful performance of its obligations, has written a letter to one of the aldermen saying he would be here soon to file the bond and that the line would be built. If it should be put in, Paris would have three telephone lines.

SAN ANTONIO, TEX.—The city council at a regular meeting refused to pass an ordinance requiring all telephone, telegraph and electric light wires to be placed underground in the business portion of the city.

TENNESSEE.

COURTLAND, TENN.—An effort is being made to establish a telephone exchange here. Many of the large planters live in town and have no means of communication with their plantations. These, with the business houses, would furnish a sufficient number of subscribers. If the system is established, it will have connection with the long-distance 'phone.

LANEVIEW, TENN.—A telephone line is contemplated to run northeast to connect several prominent farmers in the neighborhood of Laneview. When this line is built, the Bradford connection will be taken up and probably built.

MEMPHIS, TENN.—The Independent Telephone Company of Memphis, Tennessee, has received over 2,500 orders for telephone service, and the work on the new exchange building and the pole and conduit construction is being rushed. The company expects to begin service not later than January 1.

MORRISTOWN, TENN.—The East Tennessee Telephone Company has asked the United States Court of Appeals here to enjoin the officials of Morristown, Tennessee, from alleged persecution of that corporation. The company alleges it was granted a franchise legally to operate a telephone system, and the town is now trying to repudiate it.

VERMONT.

BURLINGTON, VT.—The Addison County Telephone Company is extending its line to North Ferrisburg so as to make a Burlington connection.

MIDDLEBURY, VT.—The New England Telephone Company is installing fifty new instruments in Middlebury.

WASHINGTON.

SEATTLE, WASH.—The Automatic Telephone Company, of Seattle, Washington, has made a satisfactory showing to the Board of Public Works, and that body has granted permission to set poles. The company is working hard on the construction of conduits in the business section.

SPOKANE, WASH.—Eastern capital is interested in a plan to construct a telephone system thru northern Idaho towns connecting with Spokane, Washington.

SPOKANE, WASH.—T. C. Griffitts, attorney for W. H. Fernald in his suit against the Spokane & British Columbia Telephone & Telegraph Company, states that he will continue foreclosure proceedings against the telephone company for the $15,000 mortgage held by Mr. Fernald. Mr. Griffitts is also attorney for Slater and Kirkendal, stockholders, who asked for the appointment of a receiver.

WISCONSIN.

DE PERE, WIS.—The work of rebuilding the local system in De Pere, Wisconsin, has been begun by the Wisconsin Telephone Company.

FOND DU LAC, WIS.—The Wisconsin Telephone Company, one of the defendants in the case brought by Louis Lesselyoung, administrator of the estate of Walter N. Lessel-

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young, has filed an answer to the complaint, denying all of the allegations except that the young man was killed and that the horse was a spirited animal, and that the deceased did not take proper precaution.

FOND DU LAC, WIS.—The North & East Bristol Telephone Company, who some time ago secured a franchise for running their lines into the city of Columbus, will soon begin building in that direction. President Schernecker said that the work would be begun as soon as the material could be secured. The demand for telephone supplies is greater at the present time than the production, and the company is necessarily delayed. They intend, however, to complete the line this fall, and in the spring will continue to Beaver Dam and Fond du Lac.

FRANKSVILLE, WIS.—A new telephone company was organized at Franksville for the purpose of building and maintaining a telephone line from Franksville to Thompsonville. The company will be known as the Franksville & Thompsonville Telephone Company. The company will build a metallic line, using the standard electric telephone and work will be commenced at once. At the first business meeting of the company the following persons were elected for one year: President, G. J. Ellis, Thompsonville; Vice-President, George Adams, Franksville; Secretary, F. W. Morris, Franksville; Treasurer, Dr. Carr, Franksville; Board of Directors, W. H. Owens, Henry Swartz, Henry Crane, W. Z. Rogers, G. R. Baker, Franksville.

KENOSHA, WIS.—An ordinance is being drawn up to cause the telephone wires to be placed underground. In order to anticipate the demands of the city, the telephone company has cabled many of its wires.

LADYSMITH, WIS.—The stringing of the wires of the Chippewa Valley Telephone Company from Barron to this place has been completed, and work will now be started on the local exchange in this city.

MADISON, WIS.—The Interurban Telephone Company, of this city, has filed articles of association with the secretary of state, its purpose being to construct, operate and maintain a system of telephone lines and exchanges in this State, and which may be extended outside the State. The capital stock is $200,000, and the incorporators are: A. L. Hutchinson, H. E. Kepler and Charles Schernecker.

MADISON, WIS.—The Dane County Telephone Exchange Company, at Madison, Wisconsin, has added to its local list 250 new subscribers, making a total of 1,325 in all. A new switchboard, to cost $20,000, is soon to be installed.

MARSHFIELD, WIS.—Dr. H. S. Wahl, of Stratford, Wisconsin, is now the sole owner of the line from Stratford to Marshfield, Wisconsin, having bought the interests of H. L. Klemme.

MARSHFIELD, WIS.—At a recent meeting of the board of directors of the Marshfield Telephone Company, the following officers were elected for the ensuing year: Dr. K. W. Doege, president; E. E. Winch, vice-president; F. A. Cady, secretary; E. L. Reese, treasurer.

MENOMINEE, WIS.—The Green Bay & Lake Michigan Telephone Company has been organized, with ex-Governor Edward Schofield, of Oconto, Wisconsin, and A. L. Hutchinson, of Weyauwega, Wisconsin, at the head. The company has applied for franchises in Escanaba, Menominee, Marinette, Oconto, Green Bay, Sheboygan and Manitowoc. It will build toll lines connecting with the Independent system of the company. E. T. Munger, of Havana, Illinois, president of the Havana Telephone Company, has been engaged as superintendent. The new company will offer house telephones at $1 per month, and office instruments for $2.

MILWAUKEE, WIS.—The Independent Consolidated Telephone Company. Capital stock, $500,000. E. T. Fairchild, of Milwaukee, is the president.

MILWAUKEE, WIS.—Lester Lees, who went to Milwaukee recently to accept a position with the Wisconsin Telephone Company, is well pleased with his position.

MILWAUKEE, WIS.—Plans are being made by a committee of the Badger State Long-Distance Telephone Company to adjust the indebtedness, and extend the lines. The company has property valued at $60,000, on which there is a bonded indebtedness of about $30,000.

OREGON, WIS.—Articles of incorporation have been filed for the Oregon Telephone Company; capital stock, $5,000; incorporators, J. H. Jones, William Soden, J. M. O'Brien, S. J. Barry, W. L. Ames, J. W. Emmons and H. M. Haskell.

RIO, WIS.—A long-distance telephone line from Rio has been extended to the town of Otsego, and will run thru to Columbus.

WEST VIRGINIA.

HANOVER, W. VA.—The entire stock of the Winchester Telephone Company has been sold at prices very satisfactory to the holders, to Messrs. S. L. Johns, H. N. Gitt, G. D. Gitt and T. J. Neill, of Hanover, Pennsylvania. The management of the Winchester Company will continue as at present, and there will be no change in the rates or telephone service, but great improvements and extensions will be made in the line and equipment, and the Winchester end will be operated in close connection with the other companies held by the same owners — the Hagerstown, Chambersburg, Hanover, Gettysburg and Frederick county (Md.) companies. Long-distance connection by best copper wires north and south is an assured fact in the near future.

LEETOWN, W. VA.—The Winchester Telephone Company will soon extend the line from Leetown to Middleway in Jefferson county.

OTHER STATES.

FLAGSTAFF, ARIZ.—Flagstaff and Williams are now connected by telephone.

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WEISER, IDAHO.—The council has notified the Idaho Independent Telephone Company to begin operations here within sixty days, as provided by its franchise.

PERRY, LA.—A new telephone line has just been completed, running north from Linden to the old Greenvale postoffice. This line is seven miles long, with numerous branches.

BOZEMAN, MONT.—The Pass Creek Telephone Company that has established a line for the use of the farmers in this vicinity, is beginning to put in 'phones at different farmhouses and so far they have proved successful.

HOMER, NEB.—A telephone line is being built here from Homer.

BAKER CITY, ORE.—A new telephone line is to be established between this city and the Virtue mine. This service has been needed for a long time, but the increased activity in the Virtue district that has now begun makes it a necessity. The stage line that was recently established between Baker and the Virtue is giving entire satisfaction and is being liberally patronized.

FOREIGN.

ALASKA.

FORT EGBERT, ALASKA.—The telegraph line to Fort Egbert, Alaska, was completed, and the War Department now has complete communication with that point.

AUSTRALIA.

MELBOURNE, AUS.—A deputation recently waited upon the Victorian Postmaster-General to urge the establishment of direct telephonic communication between Melbourne and Geelong and Ballarat, distances of about 60 and 120 miles, respectively.

ENGLAND.

LONDON, ENG.—The first cable for a telephone line between Brussels and London will be laid. The distance is 250 miles, fifty-six of which will be under water. The cost of the construction of the line will be £34,000.

GERMANY.

BERLIN, GERMANY.— Berlin, Germany, is to be equipped with a Chicago telephone system which has been under test for fifteen months.

POLISHING VULCANITE.

Remove scratches with a smooth wet Water-of-Ayr stone, and polish (in the lathe if possible) with fine pumice and a stiff brush. Too high a speed on the lathe will heat the work. After washing the pumice off, polish with whiting and soft brush. Lampblack and oil applied while the work is running in the lathe will give a very high polish, or the bare palm of the hand may be employed to give a good finish.

TRADE NEWS.

THE Electric Appliance Company has issued neat supplementary circulars giving full information regarding its new No. 36 Cabinet type wall telephone.

THE Western Telephone Construction Company, Chicago, has just closed a contract to install a complete central battery system of 2,400 lines capacity for the United Telephone & Telegraph Company, of Altoona, Pa.

The "Western" is now installing a complete central battery equipment for the Binghamton Telephone Company, Binghamton, N. Y., and shortly will commence the work of equipping the Glens Falls Telephone Company, Glens Falls, N. Y., and the Pan Telephone Company, Fort Smith, Arkansas, exchanges, with the same type of apparatus.

Altho only recently having moved into its new factory at Winthrop Harbor, Illinois, with greatly enlarged factory space and additional machinery, the "Western" has been compelled to increase and work its factory force both day and night, in order to keep pace with its large business, which is now the largest in the history of the company.

TELEPHONE OATH.

It is said that the legality of an oath taken by telephone is in dispute. There can be no question as to the vigor and emphasis of some of these oaths, however.

FOR SUBMARINE TELEPHONING.

A French engineer by the name of Marche claims to have solved the problem of telephoning by submarine cables for great distances. His experiments are reported as having been very extensive and exhaustive, and as having resulted recently in his being able to transmit a telephone message, with perfect distinctness, from Calais, thru a cable ten miles long.

GLUE FOR METALS.

Mix 16 parts of melted glue with 1 part of gum ammoniac; then add 1 part of saltpetre acid.

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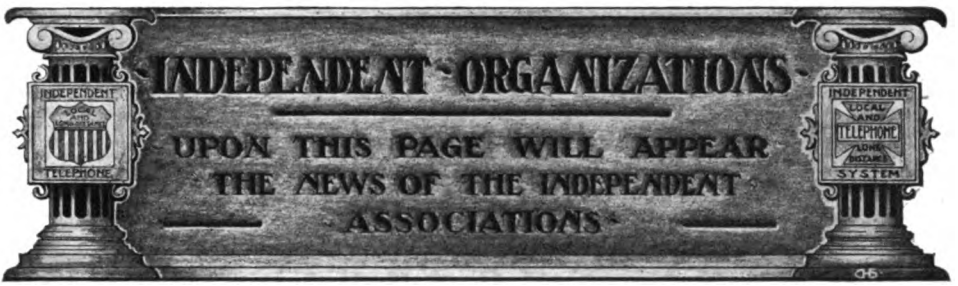

KENTUCKY TELEPHONE ASSOCIATION.

The second semi-annual convention of the Kentucky Telephone Association adjourned after a thoroly enjoyable and beneficial meeting.

The following officers were elected for the ensuing year: President R. S. Bishop, of Cynthia; vice-president, H. K. Cole, of Owensboro; secretary-treasurer, James Maret, of Mount Sterling. The Executive Committee stated that they would designate Louisville as the place for holding the next convention.

Mr. H. K. Cole, of Owensboro, read an interesting and instructive paper on "Exchange Service." His treatment of the subject showed a deep knowledge of the manner in which local exchanges should be best managed from the standpoint of economy and good service to the subscribers.

Mr. J. S. Brailey, general manager for the Central Construction Company, which is putting in the new exchange in Louisville, then read a paper on "Long Distance," which was considered the most valuable on the program. It was received with liberal applause and he was complimented for his effort. He laid particular stress on the long distance connections being made by the Kentucky and Indiana Independent Telephone Company, and stated that within the next few months this work would be completed and nearly all of the principal towns and cities of the State will be connected by competing lines. The initial line is between Louisville and Lexington, and lines will now be built from Louisville to Owensboro, Indianapolis and other points.

The following companies were represented in the convention:

Louisville Home Telephone Company, J. A. Armstrong and W. C. Polk.

Independent Long Distance Telephone & Telegraph Company, Louisville, J. C. Zeluff.

Central Construction Company, James S. Brailey, Jr.

Fayette Home Telephone Company, Francis Douglas.

Stromberg-Carlson Telephone Construction Company, R. Brinck Tyler.

Winchester Telephone Company, D. L. Pendleton.

Old Kentucky Telephone & Telegraph Company, David Prewitt.

Mount Sterling Telephone Company, S. T. Prewitt.

Maysville Telephone Company, D. L. Pendleton.

Cynthiana Telephone Company, R. V. Bishop.

Lancaster Telephone Company, A. H. Bastain.

Frankfort Telephone Company, W. W. Longmoor.

Versailles Telephone Company, James S. Brailey, Jr.

Hawesville Telephone Company, W. E. Ford.

Harrison Telephone Company, H. K. Cole, J. W. Slaughter and other members of the company.

Nicholasville Telephone Company, D. M. Murphy.

Henderson Telephone & Telegraph Company, James R. Rash.

Green River Telephone & Telegraph Company, H. R. Donovan.

Morganfield Telephone Company, J. K. Waller and J. R. Lamie.

Uniontown Telephone Company, C. P. Cissell.

Hartford Telephone Company, J. M. Mattingly.

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WANTED,

WANT ADS.

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STOCK WANTED,

CAPITAL WANTED,

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Telephone Magazine

VOL. XVIII. CHICAGO, NOVEMBER, 1901. No. 122.

CROSS-TALK IN TELEPHONE CABLES WITH WIRES LAID UP IN FOURS.*

BY JUL. H. WEST.

Calculating the electrostatic capacity in telephone cables, we find that we get lower capacity when the wires are laid up in fours than if they are laid up in separate pairs. In the former method the two wires lying diagonally opposite one another form the two conductors of each metallic circuit, and the calculation assumes that the planes of the two circuits will be normal to one another, so that the induction between both loops or circuits is balanced. It being of great importance, especially with long telephone cables, to lower as much as possible the electrostatic charge of the cable, the Postoffice decided, in giving the order for the cable from London to Birmingham, that the wires should be laid up in fours; but when the greater portion had been put down cross-talk was observed between the two loops of each four-strand. For this reason the rest of the line was made with wires laid up in pairs. In this article the reason why cross-talk appears and some means of eliminating it are discussed.

Fig. 1 represents a bundle of four wires insulated from one another by means of paper wound round each wire. As long as this bundle is *not* stranded each wire will be concentric to the paper covering, as represented in Fig. 1, the wires resting on the edges of the loosely wound paper strips. But as soon as the bundle is stranded a pull occurs, which draws the wires (1) inward toward the axis of the bundle, and (2) round the axis in the direction of stranding. As this pull only acts on the wires themselves, and not on the paper coverings, the wires are drawn out of their concentric position to the coverings, as shown in Fig. 2, in which figure the arrow *p* indicates the direction of the stranding. The first effect of stranding the bundle is, therefore (as it is also

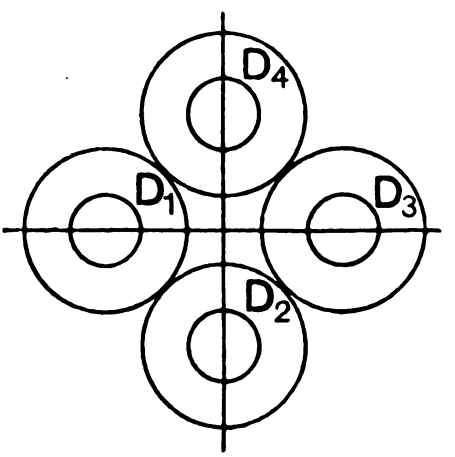

FIG. 1.

the case with the wires laid up in pairs), to increase the capacity by bringing the wires closer together. The effect is greater the tighter the wires are stranded, and therefore it is good to take as long a lay as possible. But even now no cross-talk will occur, the planes *ab* and *cd* of the two loops being still at right angles to one another.

In practice the cross-section of the

*From the *Elektrotechnische Zeitschrift*, October 3, 1901.

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strand will never be as illustrated in Fig. 2, for the reason that in stranding the four wires together the four drums which carry the four wires will never have the same friction, one rotating easier than the others. The result is that one drum will effect on its wire a greater pull than the other drums on their wires, and this difference in the pull must necessarily cause a change in the cross-section of the bundle. This may be shown in the special case that one drum is rotating with very high friction while the other drums are rotating easily. In this case we get the section shown in Fig. 3, in which D represents the wire on which a strong pull is exerted, so that the wire D is pulled so tight that it forms the center

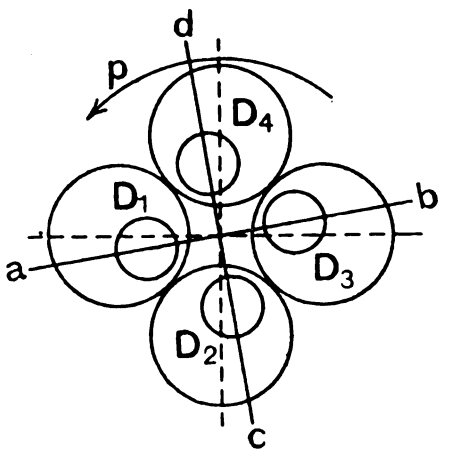

FIG. 2.

of the strand, while the three other wires, D_2, D_3 and D_4, are wound spirally round D_1, lying at first on the right side of D_1, then passing above it to the left side and returning below it to the right side again. The paper covering of D_1 will be pressed out to the other side, so that D_1 lies eccentric in its insulation but symmetrically to the insulations of D_2, D_3 and D_4. The smaller pull exerted on the wires D_2, D_3 and D_4, running spirally round D_1, forces these wires, as in the case of Fig. 2, not only centripetally toward the center of the strand — i.e., toward D_1, but also parallel to the direction of stranding, and in this way the section represented in Fig. 3 is obtained. From the sketch it is seen at once that the plane *ab* of the one loop is *inclined* to the plane *cd* of the other loop; to show this more clearly the dotted line *ef* represents the normal to *ab*.

A somewhat similar position of the wires will be obtained if the pull on the wires D_1 and D_3 is greater than on the two others, D_2 and D_4. Also in this case, as in any other case in which the pull on the four wires is not of the same amount, the two planes will be inclined to each other. Now, as a matter of fact, it will be impossible in practice to obtain the same tension on all four wires, and therefore it is impos-

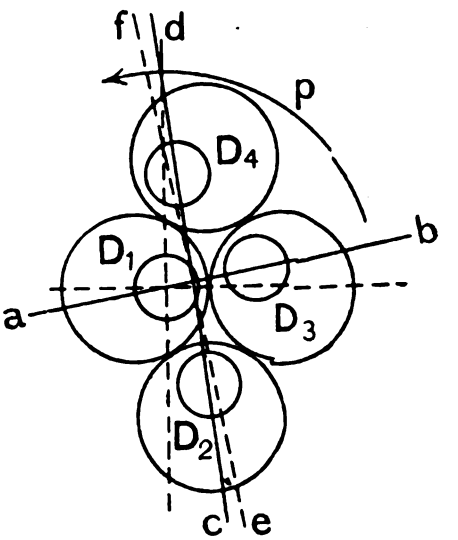

FIG. 3.

sible to obtain the section shown in Fig. 2; the planes of the two loops will always be inclined to one another, and hence the one loop will always disturb the other. It is probable that this is the reason why cross-talk is observed in cables with wires laid up in fours.

In the above remarks it has not been taken into consideration that the paper wrappings of the four wires pressing against each other lose their circular shape. It will be understood that this deformation of the paper wrapping will necessarily have the result of increasing this defect.

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The question now is, how the cross-talk occurring in this way can be eliminated; it would be useful to have a means of doing this, as every possible way of lowering the electrostatic capacity of telephone cables for interurban lines will be of practical value. There seem to be various methods. At first it is obvious that, as cross-talk has its origin in the stranding of the wires, the trouble can be lessened by stranding the wires as little as possible. This also has the effect that the wires lie further apart from one another, as it is the winding itself which pulls them together; therefore the electrostatic capacity will be lower the longer the lay is, and hence the lay should be made as long as possible with regard to the flexibility which the cable must have during manufacture and laying. Next, precautions should be taken to insure an easy rotation of the drums carrying the wires during the winding, and to secure as far as possible equal friction at all four drums.

In these ways the trouble can not be entirely removed, but only lessened. The cross-talk which will therefore occur in such cables must, then, be eliminated by means of balancing the cable when the different sections are joined together. For instance, if cross-talk occurs between two loops of a strand, then it will be easily understood that it would disappear if the strand were cut in two halves, and wires D_1 and D_3 changed — i.e., if D_1 of the one section were connected to the former wire D_3 of the second half, and vice versa. Therefore, if cross-talk occurs in a cable, it will be possible to remove it by changing the position of the wires of one loop at proper places; or, instead of changing the two wires of one loop, changing all four wires, so that after cutting the cable, D_1 of one section is connected to the former wire D_2 of the following section, D_2 with D_3, and so on.

Another method would seem to be to change the direction of the winding at intervals, that is to say, to make some lengths of cable with the wires wound in one direction (say clockwise), and other lengths of cable with wires wound in the opposite direction. If the wires of the first section are numbered A, B, C, D, and of the second section *a, b, c, d*, then, if cross-talk occurs when A is connected to *a*, B to *b*, and so on, it must disappear when A is connected to *b*, B to *c*, and so on.

These methods, of course, are not applicable to subscribers' cables containing four hundred to five hundred wires; but for such cables of comparatively short length, the gain in relation to electrostatic capacity would not be of great practical importance. With interurban cables, on the other hand, which contain a much smaller number of wires — from twenty to sixty — the work of balancing would pay. The work could easily be carried out in the following way: In laying the cable the different sections would at some places have to be connected together only provisionally, by means of small connecting boards; if, then, in going on laying the cable, cross-talk occurs, the connections at the boards would have to be changed until the cross-talk disappeared. The extra work this would necessitate would be worth while, as with the wires laid up in fours the electrostatic capacity of the line would be considerably lower than if the wires were stranded in pairs.

CLEANING FILES.

A file, to do its work fast and well, should be kept free from its cuttings, says *American Manufacturer*. Cuttings "pin" when they lodge so finely that they can not be removed with a brush. Pinning may be obviated by chalking the surface of the file, but this has the effect of reducing its bite. A little oil on the file will frequently reduce the tendency to pin. It should be used, however, only on the fibrous metals, as it glazes the surface of the non-fibrous metals, making them harder to cut. Chalk is usually applied to a file when a smooth, fine work surface is desired. The effect of the chalk is to prevent the teeth from cutting as freely as when it is not used, and thereby produces about the same result as would occur if a finer cut file had been used. When oil has been used on a file it can be readily removed by thoroly chalking.

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THE TELEPHONE IN RAILROAD SERVICE.*

BY F. P. VALENTINE.

The growth of railroad telephony in the last few years shows a gradual evolution from a public telephone on a party line with old-fashioned equipment, located in the general office or freight office of a railroad, to complete exchange systems with long-distance lines, handling a business that compares favorably in volume with that of many corporations furnishing public telephone service.

It is estimated that to-day in the United States there are some two hundred private branch exchanges operated by the various railroad companies connecting over five thousand stations, a large proportion of these having been installed within the last three or four years.

That this development has been so long delayed in comparison with the rapid growth of the public telephone service is largely due to the fact that the possibilities of economy and expedition of business have not been appreciated by either the telephone or railroad companies. The development which has taken place in the time named has been such as to arouse an interest that would indicate unlimited possibilities in the way of further development within the next few years.

The conditions surrounding the telephone service some ten or fifteen years ago were such that one telephone in the office brought most in contact with the public served to furnish such information as was desired by the comparatively small number of shippers and patrons who were able to afford, what was then considered, the luxury of a telephone. With the rapid increase in the number of the latter, with the improvement in equipment and service, and the gradual reduction in rates, the demand for communication with railroad and transportation companies increased rapidly. This naturally led to more telephone connections with the public and later to the establishment of private circuits between the various offices in order that detailed information to be given to the calling telephone subscribers might be better handled. This still increasing use led to further additions to these private circuits until the lines were burdened with a large number of instruments, causing vexatious delays in obtaining the use of the line, lack of privacy, and dissatisfaction on the part of the users. This finally resulted in the establishment of private exchanges operated by the railroad companies, with a switchboard at some central point, and having telephones located in the various departments.

These exchanges, in many instances, as first installed, were for purely domestic use and had no connection with the public, but with the rapid increase in the use of the telephone on the part of the public, it was soon found that by connecting these exchanges by trunk lines with the public exchanges and allowing calls from the public to be switched on to the telephones of the particular departments with which it was desired to transact business, a great saving in time was effected and better satisfaction given the public.

At first, only offices having business to do with the public were connected, allowing, perhaps, one telephone in each department. But the results quickly led to a rapid extension of this class of service to freight yards, towers, switch cabins, etc.

The saving in time and messenger service effected by the connecting of the various departments in large railroad offices produced economies so apparent that to-day there are few large railroad companies not equipped with this class of service. The public has grown to expect that information shall be furnished by telephone rather than by letter or telegrams.

It may be interesting to note a few of the many uses to which the telephone is now put. Starting with the ticket offices, it is astonishing how many calls there are for reservations, information as to the time of arrival and departure of trains, and the multitude of questions which may be asked by the public. These are all handled quickly and to the satisfaction of all concerned. In

* Read before the Convention of the Association of Railroad Telegraph Superintendents, 1901.

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many cases ticket offices at large terminals need to have special equipment to handle the immense volume of business which pours in from the thousands of telephones connected with the public service. In large cities one telephone in the ticket offices will hardly suffice. Persons anxious to secure reservations will call time after time, only to be given the much detested answer, "Busy." It is stated that the ticket office of the Fall River Line in New York is one of the busiest in the country from a telephone point of view. As an illustration of what the public has to suffer from insufficient telephone facilities, it is interesting to note that here even with a branch exchange having five trunk lines to the public, with a telephone in the ticket office, with one man giving his entire time to the reservation of staterooms and with the switchboard operators relieving him of many calls by giving general information when reservations were needed, the lines were still reported busy sixteen hundred times in one day. As may be imagined, such a state of affairs brought serious criticism from the public, and it was necessary in this case, in order to relieve the congestion on the wires, to double the number of trunk lines, holding them exclusively for incoming business, while other lines were installed for the outgoing traffic. A small turret switchboard was installed in the ticket office having several lines to the main branch exchange switchboard. This enabled the clerk in the ticket office to handle several lines at once and in an emergency two clerks could be taking the calls and giving out the reservations. When the number of calls for the ticket office was greater than could be handled on the lines between the switchboards, the operators were instructed to take the numbers of the subscribers and call them up in rotation as they were able to handle them.

The conditions in this case were almost the reverse of the usual use of a branch exchange, for ordinarily calls coming in over the trunk lines are switched to many different points, while here the bulk of the business was for one office.

The utility of the telephone in freight offices is also very apparent, as calls for rates and information as to shipment or delivery can be quickly furnished.

At one of the largest freight yards in this country, having a completely equipped branch exchange connecting all points thruout its various houses and yard points, a person expecting incoming freight, upon obtaining connection with the switchboard and stating what is desired, is promptly connected with one of three clerks, whose duty it is to furnish such information. These clerks, by the use of various direct lines to the offices concerned, are able, within a minute or two, to give the calling subscriber definite information as to arrival or non-arrival of the desired freight, and, if it has arrived, to inform him at what door of a certain freighthouse his teamster should go to find it.

Many receivers of freight are notified at once by telephone of the arrival of freight instead of waiting for the usual written notice, thus securing a prompt removal of the goods and relieving congestion in the freighthouses.

As telephone users increase in number it will undoubtedly be found more satisfactory to all concerned to notify by telephone rather than by mail and, with proper precautions, a record and check of the receipt of the notice may be kept. While many question the advisability of giving rates over the telephone, the cases of dispute in regard to the rate quoted form a small percentage of the whole, and, in important cases, the rates quoted may easily be confirmed in writing.

Where freight is transferred from one road to another, cars not accompanied by way-bills may be saved needless switching by prompt communication by telephone and, in many instances, it will mean a saving of twenty-four hours' delay in forwarding a car to its destination, which, in case of perishable freight, may save heavy claims for damages. Way-bill corrections may be made in this manner without delay and with no more liability to error than in the case of telegrams.

The telegraph lines of a railroad company at points but a short distance

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apart about the yards are often burdened with much business that could be transacted far more quickly by telephone. There are many instances where yard offices within half a mile of the main office, equipped with telegraph, are handling messages on thru wires, delaying other business, when a few dollars expended on telephone circuits would relieve the situation and give better satisfaction.

Where there is much competition for business between different roads, it is often necessary for a traveling agent to get into immediate touch with his superior. If he can step to the nearest pay station and call up the local switchboard of his company and thru them be connected with headquarters of his company, in two or three minutes the matter may be settled, perhaps resulting in the securing of business that otherwise would go to a competitor.

Insufficient telephone equipment, resulting in the constant inability of prospective shippers to get into communication with railroad offices, will often lose a large amount of business when an immediate decision must be made, and it is found that the offices of a competing road are, thru adequate telephone facilities, easily reached.

A certain telephone company, noticing such a situation, took pains to have the lines of the two competing railroads monitored, and the result showed that the road whose telephone was constantly reported "busy" lost enough business to its competitor in one day to pay the rental of a complete branch exchange equipment for a year.

In one case of a large terminal, embracing six large freight yards within a distance of nine miles, thru all of which runs a double track main line averaging several hundred trains per day, every tower and switch cabin is connected to a switchboard in the passenger station, keeping dispatchers, yardmasters, towermen and switchmen in close touch with one another. Many switching movements have to be made on and across the main line tracks, it being necessary, of course, to keep the line clear when trains are due. Now that all concerned are kept posted on the situation by telephone, it is possible, in case the main line trains are delayed, to continue switching movements to a safe time limit, whereas, before, delays were inevitable. The yardmaster is enabled to follow movements so closely by being kept informed from the various points, that a saving of two switch engines has been effected over the number in use before the telephone service was installed.

One of the largest passenger terminals in the country has a very complete telephone service, the main exchange being located in the office building. Every official has direct connection from his desk to the exchange. The general yardmaster, the trainmasters, towers and cabins are all connected to the switchboard, besides having direct lines to the points with which they have most business. The main interlocking tower, which controls all the yard movements incidental to handling seven hundred and fifty odd trains per day, has a special switchboard, to which are connected the outlying towers, switch cabins, yardmasters, signal bridges, etc., with trunk lines to the main exchange. Incoming trains are reported to the operator by telephone, and he is constantly in touch with every movement being made. Not a telegraph instrument is in use at any of the yard points, the telephone being the only means of communication. The yardmaster also has a small switchboard, giving him direct connection with the various points he has to reach. In case of a bad fog, when the signals can not be readily seen, men are stationed at the signal bridges, on which are placed telephones in boxes connecting with the switchboard in the interlocking tower, and the trains are handled without delay and with safety. There is hardly a place in the immense plant where any man is stationed, having special duties, that can not be reached at once by telephone. All wires are underground — not an overhead wire in the yard — and there has yet to be an instance of any failure in the service night or day.

In installing telephone systems, a great mistake is often made by railroad

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companies in endeavoring to economize in the number of instruments. Enough should be provided to care for every branch of the service under any conditions that may arise. This is especially true in relation to offices handling train service.

The branch exchange should not only afford connection with points in the immediate vicinity of the terminal, but it will be found advantageous to extend the lines to the outlying towers and stations, supplementing the telegraph service, and in many cases economizing in the number of telegraph operators it is necessary to employ, as there are many stations and towers where it is unnecessary to issue train orders, and the use of the telephone relieves the telegraph wires of miscellaneous business which often delays more important matters.

If the extension of these lines from the switchboard is carried out, so that a pair of wires is run along the main line thru the more important divisions, such wires also become valuable in emergencies. If a wrecking car is equipped with a compact telephone set, as soon as the car arrives at the scene of the wreck, instant communication may be established with the dispatchers and division headquarters by means of these division lines. Several instances have occurred recently demonstrating the value of this emergency service, where a telephone was attached to a telegraph pole within a few feet of the wreck, connected with the wires running to the switchboard at division headquarters, allowing the division superintendent, who was on the ground before the wrecking car arrived, to keep in touch with the dispatcher and the towers on each side of the wreck, and, as soon as one track was clear, permitting the movement of a number of delayed passenger trains with little loss of time. In this case no telegraph was available, but it was the opinion of the superintendent that, had it been, the work could not have been accomplished with equal satisfaction or expedition.

These wires running thru the division, connecting towers and stations, also become valuable to section foremen and signalmen to communicate with headquarters, if a test set is carried or telephone boxes are established at intervals. An emergency telephone set might be carried in the baggage car of a train, enabling a train disabled between stations and towers to report the trouble at once.

It is of great advantage to connect the various block signal stations by telephone as well as by telegraph, thus relieving the train wires of messages between towermen, which they are often unable to send promptly, as the wire is in use for train orders. A simple expedient is to utilize two of the wires used for the bell or locking circuits between towers. By the use of a two-way strap switch, a telephone may be thrown into the circuit on either side and the towermen may hold communication.

In some instances block stations on entire divisions have been equipped by telephone on lines running to switchboards at division headquarters to the exclusion of telegraph, and all business with and between the towers is transacted by telephone. This has a distinct advantage in the fact that special training is not necessary in the towermen, as they may be recruited from the men having actual experience in the handling of trains and not necessarily telegraph operators. It also affords a field for employes of the road who have been disabled in the service and are unable to take other positions. This results in bringing into the service men whose experiences makes them more valuable as towermen than would be the case were the choice restricted to telegraph operators.

The railroads terminating in New York and Jersey City have a problem which does not confront roads in inland cities in having to float many of their cars from the docks of one road to the docks of another. The railroad having the largest floating equipment moves, in this manner, in the neighborhood of two thousand cars per day. This float service is necessarily slow and, to obtain the best results, must be under a control similar to the train service. This has been accomplished by estab-

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lishing a telephone dispatching system, so that the various captains of tugs and floatmasters report and receive orders both on arrival at and departure from the terminals. The yardmasters and all concerned are notified of these movements and, knowing what cars to expect, are enabled to arrange for prompt movement upon the arrival of the floats. By the use of this telephone dispatching system an appreciable increase has been made in the number of cars handled daily, and an economy in tug movements.

While it is universally admitted that the use of the telephone under the branch exchange system at terminals is essential, it is only recently that progress has been made in connecting the various terminals by long distance lines. This has opened up a new field, and the results obtained by connecting the various switchboards in different cities along the lines of the railroads are leading to serious consideration on the part of the railroad officials of extensive additions to this service. The fact that a general officer, sitting at his desk, is enabled to communicate almost instantly with his subordinates at all points on the line effects great economy in the transaction of business and excels in value the use of the telegraph or train mail. The fact that principals can deal direct with one another instead of thru the medium of a telegraph operator has much to do with this. Five minutes' conversation will often accomplish more, with definite results, than half a dozen letters or telegrams, without the delay involved in handling the matter by the latter means. The railroads that have established these long distance lines are finding constantly increasing use made by the various departments, from executive down.

While the expense of installing these lines makes it necessary to economize in their use, it is astonishing how much business may be transacted daily over one pair of wires, if the service is properly handled. From records taken, the average length of time consumed per connection on railroad business for calls between distant points appears to be about three and one-half minutes.

WIRELESSNESS.

BY EDWARD J. WAKEMAN.

Mr. Marconi has designed a portable outfit especially adapted to requirements in wartime as an outcome of experience gained in the use of wireless telegraphy for military purposes in South Africa. The inconvenience caused by the absence of the poles which are essential in his system led Mr. Marconi to devise a portable installation, and for some time past he has been experimenting with huge cylinders to act as receivers in lieu of the high wire. These cylinders are said to have proved to be more efficacious for the transmission of messages over short distances than the ordinary apparatus. When the electric currents are excited the waves at first oscillate very rapidly and violently, but in a few moments the vibrations die down, or become damped, in much the same way as the wire of a piano decreases its vibrations after a note has been struck. It is imperative that these vibrations should be sustained as much as possible, in order to travel over a long distance, and to insure this end there must be a great capacity in the sending instruments. The effect of the cylinder is to render greater capacity than the ordinary aerial wire, and consequently more sustained vibration is obtained. The rear part of the automobile is fitted up as an operating-room, containing instruments and electric batteries. Upon the roof of the car the long cylinder is placed, and the arrangements are such that, when not required, the cylinder may be laid down flat upon the roof, out of the way. The cylinder is about twenty-five feet in height. It is constructed of metal and thoroly insulated, and can be raised or lowered instantaneously. The car, owing to the strength of stability of its construction, is a typical vehicle for military work where rough roads are encountered, and makes a speed of from twelve to fourteen miles an hour. One special recommendation of this novel installation is that communication can be maintained while the vehicle is traveling. The maximum distance over which messages can be dispatched and received by means of it is twenty miles at present.

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which is taken to be generally sufficient for military purposes. The inventor, however, is still continuing his experiments with a view to increasing this distance. The cylinder performs exactly the same functions as the aerial wire, even in connection with the tuned or synchronized messages.

MARINE WIRELESS TELEGRAPHY.

On the arrival of the Campania of the Cunard Line in New York two marvelous tests of the Marconi system of wireless telegraphy were disclosed. One was the dispatch of a message from a Campania passenger to Philadelphia by way of Ireland twenty-four hours ahead of the arrival of the Campania in New York. This was accomplished by sending the message to the Campania's sister ship Lucania, bound in an opposite direction, when the latter was 170 miles distant. The two vessels were full 1,100 miles off the Irish coast at the time. The Lucania, having less distance to traverse, wafted the message to the wireless instrument at Crook Haven when she reached the radius of electrical communication, and it was then sent to Philadelphia by cable. The man who received it in Philadelphia had ample time to come to New York and meet his friend.

The second test was almost as wonderful. When the Lucania, bound east, was still a hundred miles off the Irish coast, a message was received on board from Crook Haven from a man in Paris, who sent a welcome to one of the Lucania's voyagers and arranged for a meeting in London.

The Campania on emerging from Queenstown on October 20 plunged into a fresh westerly gale and a high head sea that sent waves slamming over her forward turtle back.

This weather continued almost thruout the voyage. It was still blowing fresh from the westward and a high sea was running on the night of October 23, three days out, when the ether waves radiating from the pole of the Marconi instrument on the Campania picked up the current from the Lucania's instrument. This was at 12:20 P.M., and the Campania was about eleven hundred miles out from Queenstown and at least sixteen hundred miles from Sandy Hook.

Complete communication was soon established and a comparison of bearings of the two ships by wireless telegraph showed that they were 170 miles apart. In less than twenty minutes the condition of those on board the Lucania from the time of leaving New York on October 19 was known on board the Campania. The Lucania was also informed of the Campania's voyage up to the time of speaking her sister ship.

One of the last messages sent from the Campania was addressed to a gentleman in Philadelphia, an acquaintance of one of the Campania's voyagers, informing the Philadelphia man of his friend's presence on the Campania.

This message the Lucania sent to the wireless instrument at Crook Haven when the Cunarder was still off the Irish coast. It was then cabled to Philadelphia. Hardly had it been sent when the Lucania's receiver began to click. The operator wrote down a message from a man in Paris, who was anxious to meet one of the Lucania's voyagers.

The telegraph communication between the Lucania and Campania at sea was kept up without interruption from 10:20 P.M., when the current was established, until 6:25 A.M. of the 24th, an interval of more than eight hours.

All this time the wind and sea were both too high to make deck promenading pleasant for the passengers. Every officer on the Campania, from Captain Walker down, was elated at the great success of the wireless system. They regarded it as a conclusive proof of the value of this means of communication at sea.

In regard to the important agreement between the Marconi International Marine Communication Company and Lloyd's, the London *Electrician* says: "We are now able to give our readers further particulars of the terms and scope of this agreement, which places the Marconi system of wireless telegraphy upon a secure and enduring footing for mercantile marine signaling and intercommunication between ships and coast signal stations. It can scarcely be un-

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known to all but a small minority that, up to the advent of the Marconi system, communications between passing ships at sea and between vessels and the signal stations operated by Lloyd's has been effected by means of a series of flags hoisted according to a prearranged code. This crude method has been in vogue for centuries, and science did not come forward with anything sufficiently practicable to obviate the use of flags until the Marconi system was shown to be effective for signaling to or from a moving vessel. Against the flag system there are many objections to be raised. Even with the use of powerful telescopes, and in the clearest and calmest weather, flag signals can not be read unless the objects in communication are within a comparatively short distance of each other; and in foggy or stormy weather, or with ships that pass in the night, flags are useless and no code signaling is in vogue — if we except simple signals, such as the pilot flare and the distress rocket. In order to signal to coast stations vessels are often compelled to make a considerable detour from the most direct course, thus always losing time, and in many parts of the world being brought dangerously close to a treacherous coast. And even after the detour has been made it sometimes happens, at certain foreign signal stations at any rate, that the keeper is not on guard and no response is given to the message of the fluttering flags, thus introducing another element of uncertainty. Moreover, the use of flags is so cumbersome that it is quite unsuitable for the transmission of commercial messages, either between ship and shore or between passing ships. It serves, indeed, for the exchange of a few remarks on, say, the prospect of wind or fog or on the probabilities of present latitude and longitude, between ocean vessels. But ships can rarely linger within the radius of a Lloyd's station long enough to flag-signal commercial messages for retransmission over land lines; besides which, the ship being within the three-mile limit, the Postmaster General would have a claim to the exclusive right of transmitting such messages. Flag signaling, therefore, is cumbersome, slow, restricted and uncertain, and quite useless for commercial communication on the sea. It is amazing that so gigantic a mercantile marine should have arisen in the world without the discovery, at a much earlier date, of a more effective means of intercommunication.

"When the Marconi system of wireless telegraphy became a proved practical success, its application to coast station marine signaling and to intercommunication between vessels was obvious. We have long maintained that in these two allied applications the Marconi system would find its most successful and widespread field of usefulness. Upon land, or between land and land across the sea, it can only compete in rare instances with the ordinary conductor system of telegraphy for the commercial transmission of messages; but on the water it stands unchallenged by any rival and has a domain of usefulness that largely is a new creation. Here, as in similar operations on land, it became desirable, if not imperative, that there should be universal employment of a standardized system, in order that ships of different mercantile fleets might all be able to communicate with coast stations or with one another. It may be theoretically true that a master patent or group of patents confers monopoly; but the records of the law courts in patent litigation show that it is risky to apply the theory to practice. The effective and practical monopoly granted by the agreement with Lloyd's is far more tangible and certain. According to this agreement, Lloyd's will employ no other system of wireless telegraphy than that of the Marconi Company for a period of fourteen years; they will receive commercial messages at their signal stations from any vessel equipped with the Marconi apparatus, and will also send messages to any such vessel, but they will receive or transmit no wireless telegraph communication whatever where a vessel is equipped with apparatus not supplied by the Marconi Company. The effectiveness of this as a security for monopoly is self-evident; even were any rival system to be introduced on other ships, the inabil-

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ity of these vessels to signal to Lloyd's, except by the old-fashioned flag system, would speedily force them to adopt Marconi apparatus. It is provided by the agreement that wherever a center for commercial wireless telegraphy with ships would be advisable, the existing Lloyd's stations at these points shall be worked on the Marconi system; or, if no station exists within about twenty miles, a new Lloyd's station will be erected at a convenient point, and, of course, be placed in ordinary telegraphic communication with the postoffice lines. Arrangements have been made by which Atlantic liners fitted with Marconi apparatus will be supplied with all the latest important news as soon as they come within about one hundred miles of America or the British Islands; and, doubtless, in course of time, the popularity of this will lead to the same being done for liners on other ocean routes. As regards the revenue which the Marconi Company expects to derive from these operations, we understand that a tariff system is being adopted in place of the rental system formerly in vogue. Signal stations are allowed free use of the apparatus for the ordinary receipt of Lloyd's signals, and vessels signaling to one another are permitted a certain number of free service messages; but, for all commercial messages a charge of 6d per word, in addition to land charges, etc., is made for each wireless transmission. Little doubt can be entertained that with the possibility of sending or receiving telegrams anywhere between the three-mile limit and eighty or a hundred miles out to sea, a large number of business men traveling on ocean liners will ere long habitually use this convenient and by no means costly means of communication; and the placing of the latest public business news on board ship as soon as the vessel comes within telegraphic reach of land would naturally tend to promote private messages.

"Presumably it will be only at special and widely distant signal stations that apparatus powerful enough to send messages over one hundred miles of sea will be installed. Obviously, where signal stations are dotted along the coast at no greater distance than twenty miles apart, it would be impracticable to employ a transmitting power exceeding twenty miles radius. Otherwise there would be overlapping and confusion of signals. Fixing the limit of ordinary signaling, therefore, at about twenty miles, it is evident that within this radius — so large compared with the radius of effective flag signaling — there might readily at times be several vessels simultaneously requiring to communicate with the shore. At the same time it would be improbable that any two of these vessels would belong to the same mercantile fleet. Trouble that would otherwise arise through the clashing of signals in such cases can, therefore, be overcome by employing the tuning system, by means of which Mr. Marconi has already been able to differentiate between the signals from the several stations in a group. Thus one fleet of liners would be provided with means for producing one particular wave-length, while another fleet of liners would be allotted a different wave-length. The coast stations would correspondingly be equipped with multiple apparatus capable of picking up simultaneously a number of messages of different wave-lengths, or of replying in a similar selective manner to the various messages simultaneously received. Those who know how long are the intervals between the Lloyd's signals received at coast stations, on the average, will readily perceive that, even with a twenty-mile radius, it is unlikely that the resources of the tuned selector system will easily or soon be exhausted. As regards the busiest signal stations — e. g., Hurst Castle, at the entrance to Southampton Water — it is evident that the radius might with advantage be considerably reduced to far less than twenty miles, and the difficulties of clashing be got over in that way.

"A word as to the future development of this system of marine signaling and the character of the growth which we believe it should acquire. In an earlier part of this leading article we have used the word 'monopoly' — a word that has only to be whispered

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nowadays in order to raise loud and emphatic protests in certain popular quarters. We have said that the wireless telegraph system for the world's mercantile fleet must be universally standardized, and accordingly must become a monopoly. It is difficult to perceive in what way perfect standardization can otherwise be created, or, if created, how it can be perpetuated as improved methods arise in the process of time. Granting, therefore, that some sort of monopoly is essential, in order that the world's entire mercantile fleet may everywhere be able to signal on a uniform system, the next question that arises is: In what authority is the monopoly to be vested? The monopoly of commercial messages on land in the United Kingdom is vested in the Postmaster-General. But land messages are mainly a purely national matter; marine signaling is international. The ships of foreign mercantile fleets require to signal to stations on British coasts; British ships require to signal to stations on foreign coasts the wide world over; and ships of all nations need to talk to one another at sea. Clearly, therefore, no single Postmaster-General can be given such authority as is required. If the monopoly is to be governmental, it will necessitate, shall we say, an international syndicate of Postmasters-General. We have only to mention such a proposition in order to demonstrate its impracticability; the wireless telegraph system of the marine world can not yet, if ever it can, be owned and controlled by national governments. On the other hand, if it ever should become practicable for marine signaling to be controlled by an international governmental arrangement, it is highly desirable that it should be so controlled. For the present, however, we perceive no other practicable way than that it should be controlled by a responsible commercial corporation or association, and, regarded in this light, the name that foremost suggests itself is Lloyd's."

WIRELESS TELEGRAPHY ON MOUNTAINS.

The Allgemeine Elektricitäts-Gesellschaft, which some time ago was commissioned by the Bavarian Postmaster-General to make an attempt to establish a connection by wireless telegraphy between the meteorological observatory on the Zugspitze — the highest summit in Germany — and the postal station at Eibsee at its base, is reported to have solved the problem in the face of many difficulties. The altitude of the observatory is nearly 3,290 yards above sea level, and the meteorologist who permanently occupies it is completely isolated during the winter months, when the roads are impassable. The telephonic communication could not be depended upon, owing to the liability of the cable to become damaged against the sharp edges of the rocks. We learn from the Berlin correspondent of the *Morning Standard* that it has now been found possible to apply the Slaby-Arco system of wireless telegraphy in such a way that the deflections due to the nature of the slopes — which heretofore have been an insurmountable difficulty in establishing a wireless connection between mountains and valleys — act favorably instead of unfavorably. Another difficulty which had to be overcome was the absence of any electrical generator, which necessitated the use both on the Zugspitze and at Eibsee of dry batteries, which give comparatively a small supply of electricity. Thanks to the system used, this was not a serious drawback, for it is said that communication can be maintained between the two stations with only a minimum of electrical energy. The instalment of the transmitter and receiver on the Zugspitze also proved very difficult. Owing to the frequent storms and frosts it was necessary to use steel wire, and since it was impossible to set up poles, the wire was fastened to the rock without insulators. The whole installation is said to have satisfied all requirements, and has been declared workable by the Bavarian Postmaster-General, who is now turning his attention to a proposal to connect the observatory with Partenkirchen, a place about three times as far away as Eibsee.

(To be continued.)

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TALKS AND CROSS-TALKS.

BY THE INSPECTOR.

HINTS TO CORRESPONDENTS.

Write on one side of the paper only, and make sketch or diagram, when necessary. Endeavor to give all the facts bearing on the case, so as to enable the editor to answer intelligently.

Name and address must accompany each letter, not for publication, but for the information of the publisher.

157. DEAR SIR,—I have a bicycle lamp storage battery which I want to renew, and find the construction of it is as follows: Outside cells of hard rubber 3¾ inches long by 1¾ inches diameter. Inside cup is porous earthen 2¾ inches long by 1¼ inches in diameter. A piece of hollow lead is in the center of the porous cup, the space around the lead is filled with a black composition. On the outside of and around the cup, but not touching it, is a piece of copper netting. What I want to know is, is this composition carbon and peroxide manganese, and what is the proportion of same? Also what is the best electrolyte for such a battery?

(Signed) BATTERY.

I have never met with a battery such as you describe. There was a battery upon the market which had a zinc tube where you mention a lead tube. In the battery which I have reference to the black material you mention was peroxide of manganese alone. At any rate, I would advise you to try an electrolyte of ten per cent solution of zinc sulphate. In case this does not work it, I would like to hear from you, and I will then reply by letter. The black material which you mention can be washed and dried and used over again.

158. DEAR SIR,—I am a subscriber of your magazine. I enclose a stamped envelope for reply to questions. (1) Would there be any cross-talk or induction to cause cross-talk in a 25-pair rubber cable, lead over all, 175 feet long? (2) Would you advise using rubber cable for that length or shorter? Thanking you in advance, I am, O. O. Z.

No, I do not think you would be troubled with cross-talk or induction in a cable of that length. I would advise the use of dry paper separation in the cable, as my experience has taught me that a paper-covered cable possesses a great many points of merit over a rubber-covered cable when properly handled.

159. GENTLEMEN,—Would you kindly help a reader out of a dilemma and tell me the difference between a bridging and series switchboard drop? Also, what is the advantage of one over the other? We have an old Bell board now which we want to throw out, and would like to find out which would be the very best, with series or bridging drops, there being about twenty-five subscribers, distance one hundred feet to ten miles, to them. Also we have two subscribers who have a long-distance 'phone in their office who can connect us to it. If you could send a sketch of both drops or refer to some publication describing them also would be of assistance. With thanks in advance, I am,

Yours very respectfully, A. H.

You could put in a board that had a number of series drops and a number of bridging drops. You do not say whether your long lines are equipped with more than one party on the line;

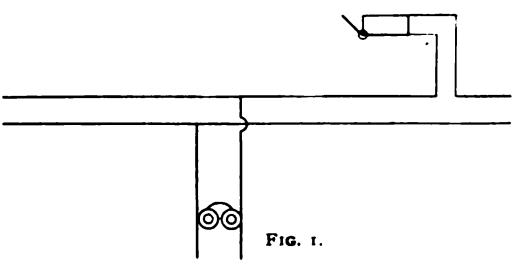

FIG. 1.

if they are, and are connected up in bridge a board of this description would be the thing you want. You could have this long-distance line run into a bridge drop, and in fact you could have as many bridge and series drops on your board as you please. There is a slight

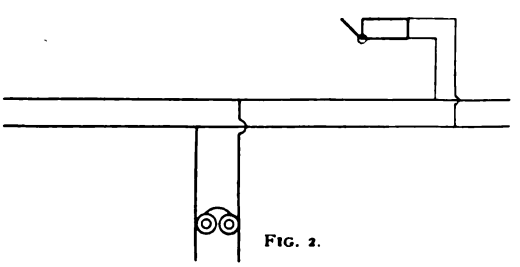

FIG. 2.

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difference in the cost of a series and bridge drop; the bridge drop being of higher resistance requires finer wire. This makes a bridge drop cost a little more than a series drop.

By referring to Fig. 1 this is the connection of a drop in series, with a telephone connected on the line in multiple or bridge. You may see from this what the effect would be. All the current to ring the bells on the line would have to pass the lines on this drop, and as the drop would be high in inductive resistance you would be unable to ring the bells on the line. Now, referring to Fig. 2, there is a drop on the same line bridged in; you will see by the connection that it divides its current with the bells.

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160. DEAR SIR,—We have a cable pair, which rings one way but not the other. If one side is connected to the common return, the other to the line, the subscriber can ring in. If the pair is reversed, the operator can ring the subscriber; line talks all right, but rings one way only. Where is the trouble?

In laying a lead-covered cable underground, whether the drainage is such that conduits can not be laid without too much expense, is either of the following ways advisable, and which is preferable?

To lay the cable in cement, making a wooden form 6 inches square, making depth about 2 feet, cement to be put directly around the cable, cable running as near to the center of the cement as possible.

Or, to lay the cable in a wooden conduit 6 inches square and fill the conduit with pitch, so that the cable will be about in the center of the conduit. It is understood that the cable can never be withdrawn for repairs, and capacity enough will be provided for to stand the loss of a few years. Is dry paper or paraffined paper the better?

Is an underground cable likely to suffer more than an aerial cable from lightning, other conditions being the same, i. e., laid in either of the above ways?

Respectfully, G. S. P.

The first trouble is caused by the fact that one wire leaks to the common return; that is, there is a partial line of conductivity established, and the generator current being more powerful than the telephonic current is able to traverse this path of conductivity. This is the reason you are able to talk over this line but not able to ring over it. This is a very mean piece of trouble to remedy, in fact, the best way to do is to let this troublesome wire remain dead.

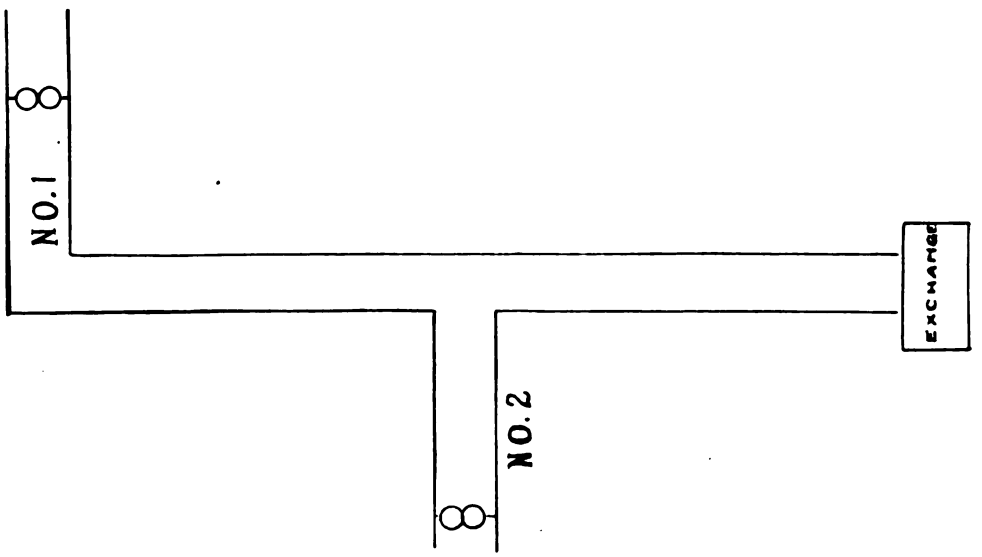

FIG. 3.

I would prefer filling the conduit with pitch, as in case of trouble you could get at the pitch cover without injuring the cable, whereas, in cement, if you cared to expose any part of the cable it will be a delicate job to get thru the cement without injuring the cable. I would

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recommend the use of creosoted wooden troughs. I am pretty sure you could secure these from your supply dealer, as I have seen them advertised. You can buy these cheaper than you can make them. Of course, if you could not secure it, it would be all right to build the way you speak of. The Underwriters' rules in regard to cables carrying lighting or power current is that the sheaf of the cable should be positively grounded. This is good practice in telephone work as well. The danger of lightning affecting a cable is not as great running underground as it is running aerial.

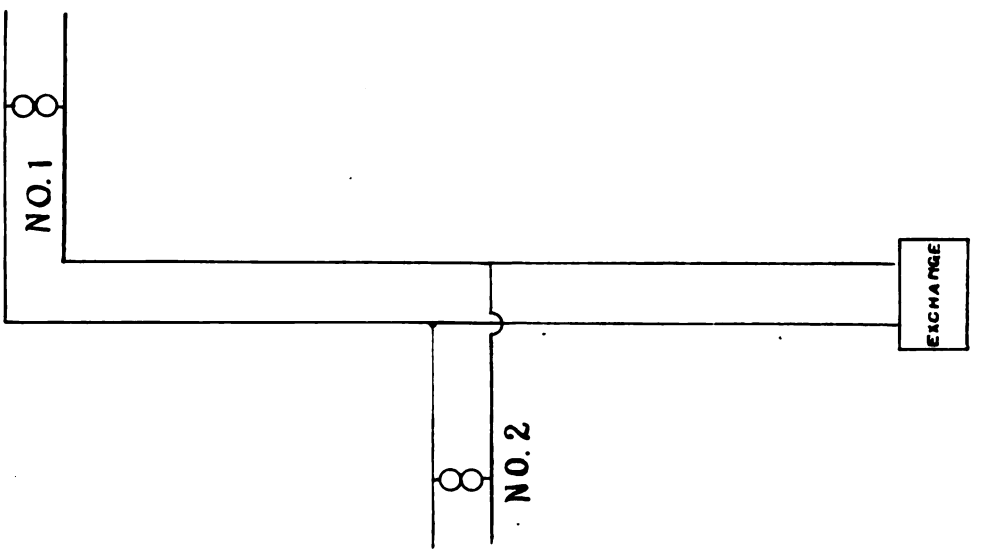

FIG. 4.

161. DEAR SIR,— I would like to get your advice on the following subject: We have an exchange of about 105 magneto 'phones on return-wire system, and are about to buy a new switchboard.

I would like to use a common-battery system, using local batteries at the 'phone, and convert my business line into metallic circuit with central batteries for signaling, and residence 'phones on return wire using magneto 'phones, and to intercommunicate the same one with another, using a switchboard. Our rates are $1 or $2 for residences and offices. Do you think it practical?

Is it possible to convert our magneto 'phones into common battery system, using local batteries at 'phone?

We propose to buy a combination switchboard adapted for both common battery and magneto, and, as about seventy-five of our 'phones will be on central-battery system, using primary batteries for same, do you think this plan practical both from a telephone and financial standpoint?

We propose to put up four hundred feet of cable. Do you advise using rubber, paper dry core, or paper saturated core insulation?

I would like to receive this information as soon as possible, and thanking you in advance, I am, Yours truly, J. P. M.

The system which you intend to adopt at your exchange has proven successful from both a telephonic and financial standpoint. I do not think your rates are high enough. What is the matter, and why do you not raise them?

In regard to the cable, I would recommend the use of dry paper separated, as I have always found this cable, when properly handled, to be superior to any other form of cable. It would be cheaper for you in the long run to buy new 'phones, altho they may be converted into common signaling 'phones very cheaply.

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162. GENTLEMEN,— Please answer thru your magazine and oblige. Is the talking voice thru a telephone an alternating or a direct current, or what is the proper name for the voice wave? C. J. W.

It can be called an alternating current. The proper name is telephonic current.

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147. GENTLEMEN,—We have two 'phones on one line. Fig. 3 is a diagram of the same. 'Phone No. 2 works fine but 'phone No. 1 rings feebly, also talks, and receiving part is weak. We have tried the same 'phone at Station 2 as at Station 1, but it works just as poorly. Could the Inspector tell us where the mistake is, or show us a better method?

A READER.

You do not state in your letter how your telephone at Station 2 is connected, but from your drawing it appears to be bridged. If this is the case, your trouble is easily remedied. You have but to connect No. 1, as shown in Fig. 4. This will bridge it across the line, and then all your 'phones will work alike. If this is not the case, I would like to hear from you again, but undoubtedly this will remedy your trouble.

163. DEAR SIR,—In the letter (No. 147) I sent you some time ago, I forgot to state whether the 'phones were series or bridged, and so you took for granted that they were bridged. This is not the case; they are both series 'phones. If we connect them up as your diagram shows they will not have enough power to throw drop at central; that shows plainly that they are not bridged. Will you kindly advise us how to remedy this?

Yours respectfully, A. L. B.

If this is the case I would recommend the use of a lower wound drop at the central station. You might remove some of the wire from an old drop, say about one-quarter of it, and adjust the drop so it will be sensitive enough to fall with that amount of wire. This should remedy your trouble.

---

164. DEAR SIR,—We have a single ground line switchboard for two hundred subscribers. How can we put in metallic board and still use grounded lines without talking over a ground? C. J. W.

Either you are not clear enough or you have found another of the many things I do not know. I trust some of my readers will see what they can do with this and let me hear from them.

STRESS AND STRAIN.

There is much confusion among writers on strength of materials as to the definition of stress and that of strain, says the *Draftsman's Bulletin.*

An external force applied to a body so as to pull it apart is resisted by an internal force or resistance and the action of these forces cause a displacement of the molecules or deformation.

By some writers the external force is called a stress and the internal force a strain; others call the external force a strain and the internal a stress.

This confusion of terms is not important as the words stress and strain are quite commonly used synonymously, but the use of the word strain to mean molecular displacement, deformation or distortion, as is the custom of some, is a corruption of the language.

Definitions by leading authorities are given below.

Stress—A stress is a force which acts in the interior of a body and resists the external forces which tend to change its shape.

A deformation is the amount of change of shape of a body caused by stress. The word strain is often used as synonymous with stress and sometimes it is also used to designate the deformation. (Merriman.)

The force by which the molecules of a body resist a strain at any point is called the stress at that point.

The summation of the displacements of the molecules of a body for a given point is called the distortion or strain at the point considered. (Burr.)

Stresses are the forces which are applied to bodies to bring into action their elastic and cohesive properties.

These forces cause alterations of the forms of the bodies upon which they act.

Strain is a name given to the kind of alteration produced by the stresses. The distinction between stress and strain is not always observed, one being used for the other. (Wood.)

There are tensile, compressive, transverse, torsional and shearing stresses.

A tensile stress or pull is a force tending to elongate a piece.

A compressive stress or push is a force tending to shorten it.

A transverse stress tends to bend it.

A torsional stress tends to twist it.

A shearing stress tends to force one part to slide over the adjacent part.

To these may be added tearing stress which is either tensile or shearing.

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Telephone Strapholders.

The Chicago *Chronicle* has this to say in regard to the inefficiency of the most excellent service the Chicago Telephone Company claims to furnish, and it is interesting for the Independents to note that this most excellent paper speaks of the efficient telephone service furnished in St. Louis and sets forth the benefit of two telephone companies — one an Independent and honest, the other the Bell Company and (———?).

"The crowding of local telephone facilities has reached a point where it approximates the crowding of local transportation facilities. In other words, telephone users are reduced to mere strapholders in a considerable fraction of the cases in which they resort to their instruments. They are crowded out of proper accommodations by the overburdening of inadequate facilities, which has been increasing at an accelerated rate of late.

"If a person has five telephone calls to make he is practically certain to have an annoying experience of bad service in one of the five instances. He will either have to wait an unreasonable length of time for attention at the start, or his subsequent signals to have the unresponding party rung again will be long unnoticed, or he will be assured by the operator that she is 'trying to get' his 'party,' whereas her failure is apparently due, not to the 'party,' but to a lack of sufficient trunk lines; or he will be 'crossed,' or prematurely 'cut off,' or indefinitely 'hung up' on some abortive and mysterious connection which neither connects nor yields answers to frantic signals, or he will receive the busy signal —'wow, wow, wow'— only to find, after trying again, that the desired line is 'out of order' and that no system exists for promptly apprising operators of such casualties and so saving subscribers from waste of time in fruitless calls. At the same time subscribers must pay charges which carry the prices of the stock of the company to from $221 to $225 per share and provoke eager application for rival privileges.

"St. Louis' telephone service is far superior to that of Chicago, is much

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more generally distributed, and costs much less per 'phone. The reason is that there are two rival companies there. The advent of the newcomer three years ago jogged the old company out of its lethargic security and compelled it to raise its service to a high degree of efficiency. To-day both companies in St. Louis are keen and approximately equal rivals for popular support. St. Louis, too, is a type of a large number of American cities where, within the last few years, the monopoly of the old telephone companies has been invaded, with the result of bringing greatly improved service, extending the number of telephones, and reducing the average cost per instrument. Of course, there is the disadvantage in those cases that every subscriber who would be in communication with all the local telephone subscribers must pay for and give space to the instruments of both companies. Nor is there any assurance — beyond the great profitableness of thus entrapping double subscriptions — against combination at any time by competitors. In other words, competition is an unreliable, inconvenient and expensive guaranty for the public. Yet it does, at least, bring good service.

"The question here is as to whether Chicago can not get reasonable telephone development, accommodations and charges from a monopoly on the basis of public regulation — which is the only alternative guaranty. Some fair and well-considered action in this direction, conceived and carried out, not in any 'grand stand' spirit, but with intelligent appreciation for the broad and legitimate interests involved, would be of great benefit to this community. The telephone 'strapholder' challenges relief at the hands of the municipal statesman," and this relief is something that must come sooner or later.

A Position for Women.

There is no vocation in the way of mercantile life that is better fitted for women than that of a telephone operator, and it can be said of this that in no way does she conflict with man in filling this position. In a woman is found the material virtues which make a telephone operator, and in this vocation woman is superior to man. For to be a telephone operator one must be possessed of patience — a virtue in man, but a necessity in woman. There are few men who can sit in one position engaged in one occupation for any length of time. In fact, it is a hardship to ask a man to do this. But with a woman it is no task. The pay of a telephone operator is good. The position is one that puts a woman on a higher plane and has no effect upon her morals.

REPLANTING OUR FORESTS.

The *Atlanta Constitution* takes this view regarding our timber resources in the South:

"In the beginning our forest lands on the North American continent were something immense and our pioneer forefathers safely reasoned that the day was far distant when there would be any scarcity of fuel or lumber in the vast wilderness which surrounded them. We have been possessed of this same idea, but we apparently lose sight of the fact that four centuries of civilization have been at work on the North American continent since we first took possession of it, and that during this long period of time we have made heavy inroads upon our forest lands, not only for the purpose of building up our towns and cities, but also for the purpose of carrying on in a large measure our commercial and industrial activities. Such being the case, it is only necessary for us to bring our minds to bear thoroly upon the subject to realize that the fulness of time has come for us to seriously consider the matter of replanting our forest lands."

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TELEPHONY.

BY DR. V. WIETLISBACH.

A vertical section of the new form of the Bell telephone is shown in Fig. 10. Its external form is the same, but the magnet is in the shape of a horseshoe, and will lift 1 kg. (2 pounds). The two pole-pieces are not cylindrical, but flat. Each is wound with about eight hundred turns of insulated copper wire. The case upon which the diaphragm lies, as well as the ring of the cover which clamps it, is of brass. It is important that the magnet be adjustable as regards the diaphragm. The magnet is fastened to the upper end of the case by a screw. Between the bend of the magnet and the case are placed a series of spring washers, which are more or less tightly packed according to the tension of the screw. The elasticity of these washers suffices to regulate the distance between the diaphragm and the iron core, the play being about 0.1 to 0.2 mm. (4 to 8 mils). This adjustment is of great value and makes it possible to use the same telephone for very short and very long circuits. When relatively strong currents are conducted into a very sensitive telephone they often cause the vibrating diaphragm to impinge upon the iron core, stopping its free motion so that hearing becomes impossible. Of course, it is not practicable to adjust the telephone for every conversation, but some instruments are usually employed for very long distances and others for short ones, so that the telephone may in each case be adjusted to the requirements of the station.

The telephone just described is to be preferred to all others for simplicity of construction and sensitiveness and distinctness in operation.

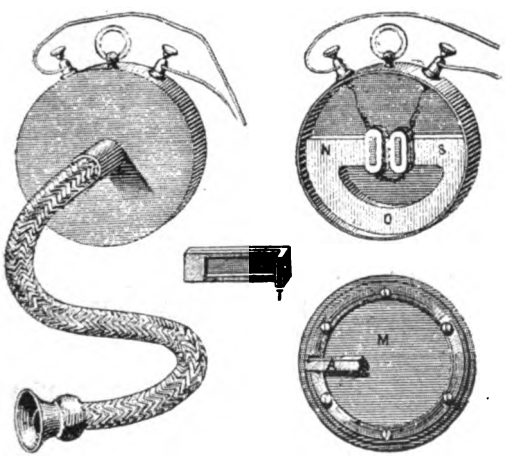

FIG. 12.

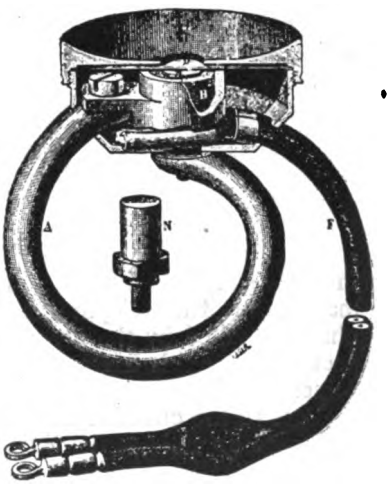

FIG. 14.

The Siemens telephone is very similar to the double-pole Bell telephone just mentioned, but its dimensions are much greater, it being used both as receiver and transmitter. Up to 1886, no microphones were used by the German Imperial telegraph administration, the Siemens telephone being the only transmitter employed. Its diaphragm is 100 mm. (4 in.) in diameter and 0.4 mm. (16 mils) in thickness, and is tinned. The flattened pole pieces (11) are 20 mm. (8-10 in.) long and 3 mm. (⅛ in.) wide. This telephone does good service as a transmitter, but as a receiver is somewhat clumsy, weighing about 1 kg. (2 pounds). A trumpet is often mounted on the diaphragm which, when blown into, agitates it violently.

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The induction currents thus generated are so strong that the receiver gives out a sound very easily audible in a large room, being thus a call given by the telephone itself, and which is very convenient for special purposes.

To avoid holding the telephone to the ear, Gower used an ear trumpet in the form of an elastic tube about 1 m. (3 feet) in length. Fastened to the case opposite the diaphragm, as shown in Fig. 12, the magnet N O S has a peculiar form, but in other respects corresponds to that of the Siemens telephone. The telephone is enclosed in a flat cylindrical case.

Ader's telephone is a convenient double-pole instrument. Its diaphragm is 50 mm. (2 in.) in diameter and 0.2 mm. (8 mils) in thickness. On account of its smallness it is adapted for use only as a receiver. The magnet A (Fig. 13) is bent

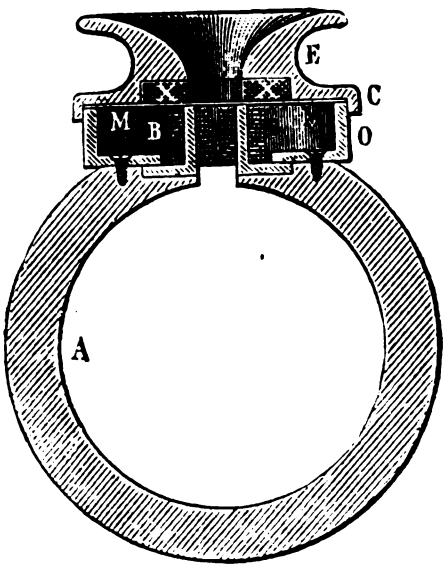

FIG. 13.

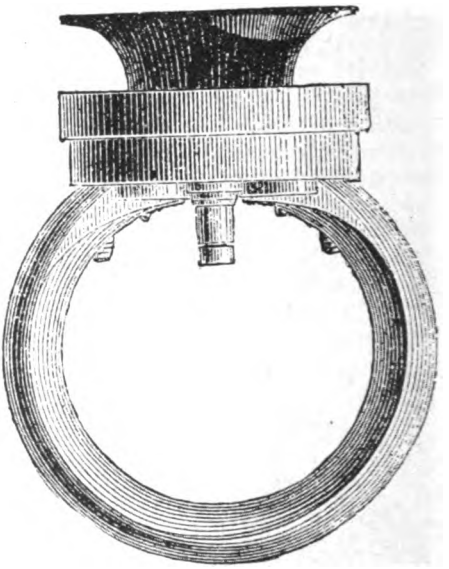

FIG. 13.

into the shape of a ring, and serves as a handle. To increase the force of the magnetism of the diaphragm an iron ring is let into the cover just above the diaphragm, called by the inventor the "Surexcitateur." The iron ring is the chief peculiarity of this telephone, but there is some difference of opinion as to its usefulness, because it is evident that the lines of force absorbed by the Surexcitateur are lost to the effectiveness of the telephone, which, in fact, works about equally well with or without the Surexcitateur.

The d'Arsonval telephone is well devised. The iron core N around which is wound the insulated copper wire B (Fig. 14) is fastened to one of the poles of the circular magnet A. A cylinder of soft iron surrounds the electromagnet and is attached to the second pole of the magnet A, thus favorably shaping the course of the magnetic lines in the diaphragm and rendering the magnetic field very sensitive to the electric waves in the magnet wire. It is often desirable to have a telephone as light as possible. Fig. 15 shows the pony crown telephone, which is unipolar. The magnet is bent into the shape of a ring and is used as a handle. Fig. 16 is the so-called "watch" telephone, a bipolar instrument. Its small horse-shoe magnet is enclosed in a small cylindrical case of brass or aluminum. These telephones, weighing scarcely 140 grams, are frequently attached to a circular spring of flat steel, which is hung over the operator's head. The head telephone is much used in

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this manner at central stations, the advantages being two, namely, the operator is not compelled to hold the telephone to the ear, which becomes in the end very tiresome, and both hands remain free for the switching service.

Fig. 17 is a representation of a so-called "spoon" telephone, used in the German Imperial Postal Service. Its construction is similar to that of the double-pole Bell telephone, with this difference, that the pole pieces instead of lying in the plane of the magnet, forms a right angle with it, making it less tiresome to hold to the ear.

The disposition of the force lines in different forms of telephones is shown in Fig. 18. It may be observed by sifting iron filings on the diaphragms. In the strong magnetic field they form a figure which shows the direction of the force

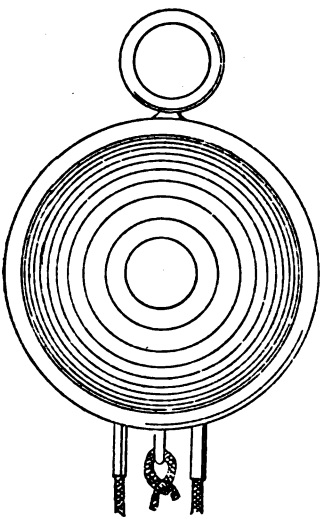

FIG. 16.

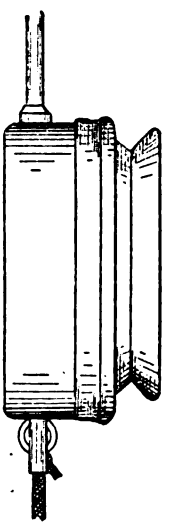

FIG. 16.

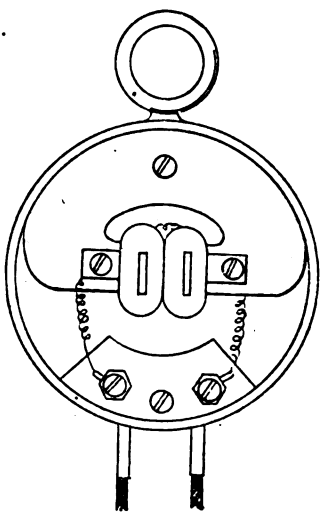

FIG. 16.

lines, which is always in the center of the diaphragm nearest the magnet. This strongly magnetized portion is always bordered by an empty space without any filings, due to the fact that the filings falling there are attracted toward the center by the magnet. On the outside portion of the diaphragm the magnet exercises no appreciable directing force.

Fig. 18*a* shows the formation of a double-pole telephone, with flat cores, Fig. 18*b* being for a single-pole telephone with round core, and Fig. 18*c* a d'Arsonval telephone. The effective portion of the diaphragm is greatest and most favorably placed in the first case.

There are many other styles of telephones, but as they have attained little or no importance in practice, and are uninteresting in other respects, we may well ignore the countless variations which appear mostly in the external, not in the operative parts. In Stubbs & Preece's (the telephone), and in Prescott's (the Bell telephone), the reader will find a large number, some being of very curious construction.

5.—THE MOTION OF THE TELEPHONE DIAPHRAGM.

It is a matter of great interest, especially for the construction of the telephone, to observe the processes of this motion by ear and also to note them by actual measurement. The vibrations of the diaphragm being too minute to be seen excepting with the microscope, it is necessary to use special means to bring them within the range of measurement. There are several ways of showing that tele-

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phone diaphragms actually vibrate and of determining approximately their amplitudes.

1. According to the method of Boscha, a bristle may be fastened to the diaphragm and the motion of its tip observed with a microscope. The tip will describe about the same course as the point of the diaphragm to which it is fastened.

2. The dancing flames of Konig, a method developed by Frolich, may also be used. If a gas burner be attached to the diaphragm and the gas lit, the flame will vibrate as soon as the diaphragm is thrown into motion. If the flame be observed in a rotating mirror we shall see a regular series of deep indentations of the most varied forms, which correspond to the motions of the diaphragm. As

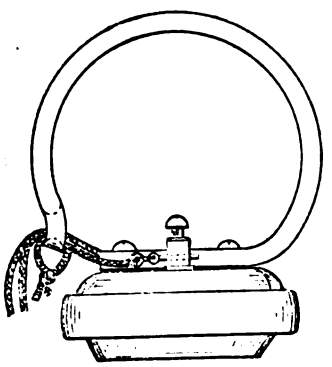

FIG. 15.

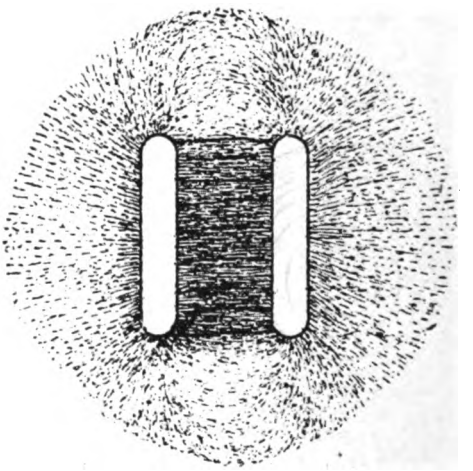

FIG. 18*a*.

these motions are very small, the space thru which the gas flows over the diaphragm should be as narrow as possible. To the middle of the diaphragm (Fig. 19) may be fastened a piece of cork slightly rounded at the end and fitting into a brass cup. If a thin membrane of rubber or fish bladder be stretched over the mouth of the cup, the space within may be so regulated by a micrometer screw that the membrane is almost pressed up against the inner surface of the cup by the cork, leaving an extremely narrow space. This will make the flame dance very perceptibly, even with the smallest motion of the diaphragm. The forms thus produced may be accurately drawn, but are not easily photographed, as their light is very feeble. The principles of acoustics will enable us to form conclusions as to the conditions of the diaphragm motion. In Fig. 20 are drawn the curves produced for various vowels at various pitches. The vowels were uttered before a microphone in circuit with a telephone, and the flame diaphragms T were produced by the diaphragm of the latter. The electric waves were also conducted thru a wire to a second diaphragm, the flame diagram thus produced being those marked M. The diagrams M and T thus show the changes both in the spoken and in the reproduced waves, the latter being in general more complicated.

3. The most exact method, also due to Frolich, is the following:

A small mirror several mm. in diameter is fastened to the diaphragm between its rim and its center. A ray of light produced by an electric arc lamp B (Fig. 21) and a lens L is directed upon it. The size of the ray is determined by the orifice in the shade S. When the diaphragm is thrown into vibration, the ray of light also vibrates. If the outline of the orifice S be cast by the lens L upon the distant

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screen E, the amplitude of the diaphragm vibration may be computed from the size of the patch of light produced by the vibrating ray. Frolich found that for the loud-speaking Siemens Telephone it was 0.035 mm. (0.00014 inch).

For the purpose, however, of getting an exact idea of the entire path of this motion, we must combine it with another well-known simple rectilinear motion. When the diaphragm is executing a simple vibration, we shall have upon the screen only a vertical line A B (Fig. 22), but if simultaneously a horizontal advancing motion is imparted to the ray, the diagram A B is drawn out into the wave line *o a p b g*, which shows not only the size of the amplitude but also the phase of the motion at any moment. This second displacement Frolich obtained by catching the ray reflected from the diaphragm upon a rotating mirror M (Fig.

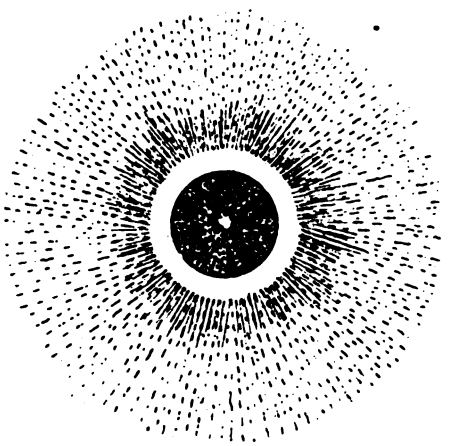

FIG. 18*b*.

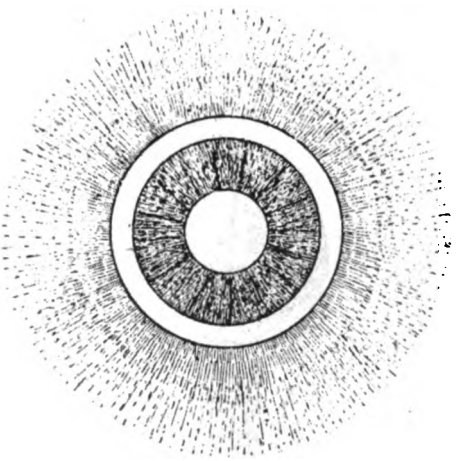

FIG. 18*c*.

21) and thence conducting it to the screen E. Upon a drum are twelve flat mirrors, carefully adjusted parallel to the axis. Turning the drum causes each mirror to throw a part of the curve upon the screen. If it is turned slowly, the separate parts of the curve will be disconnected, and will appear leaping in quick succession over the screen. The more rapidly the mirror is turned, the smaller grows the interval, until it disappears entirely when the period of separation becomes too small for the eye to note. A single curve will then be seen, which seems to be quickly moving over the screen. The more rapidly the mirror is turned, the more slowly does the curve move, until finally it stands quite still. If the speed of the mirror drum be further increased, the curve will again begin to move rapidly, then move more slowly and again stand still, and so on and on. The curve will always be at rest when the time intervening between the passage of two successive mirror reflections over a certain line upon the screen is an entire multiple of the time of vibration of the motion under investigation; for, in such case, the mirrors constantly reflect upon the same point of the screen the same state of motion of the diaphragm, and the diaphragm of the vibration is thus fixed upon the screen and may be photographed or drawn.

Frolich endeavored to ascertain primarily with what degree of accuracy the curve of the current is reproduced by the vibration of a telephone diaphragm. He took two extreme cases, namely, the meandering line produced when an electric battery is at regular intervals opened and closed in a circuit containing resistance free from self-induction; and a curve of sines, produced when a coil of wire without iron core is uniformly rotated in a homogeneously magnetic field. Fig. 23*a* shows both of the current curves. Fig. 23*b* shows the mirror diagrams produced

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by the use of an ordinary telephone diaphragm. Fig. 23*c* shows the same diagrams produced by a pasteboard diaphragm 0.8 mm. in thickness, glued to a piece of sheet iron. Fig. 23*d* shows the same diagram produced by a pig's bladder. Only the telephone diaphragm accurately produces the sine wave and the meandering line approximately. In the case of the latter, the free vibrations of the diaphragm make themselves somewhat perceptible, and it is probably that this circumstance renders the exact reproduction of consonants difficult and in part impossible, since waves of a meandering form are an essential component part of all consonants. Frolich's method enables us to ascertain not only the form of the current curve and its amplitude, but also the third element necessary for a determination of the wave motion, to-wit, the phase. For the purpose of representing this phase, a vertical wire is fastened to the screen upon which the reflection is caught, or in front of the photographic camera. This wire breaks the luminous curve at a certain point and gives us a fixed mark. A telephone connected in at one of the two points between which there is a shifting of the phase will, if the mark is located upon, for instance, the crest of the wave, enable

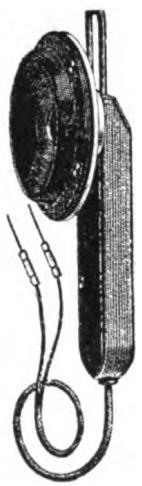

FIG. 17.

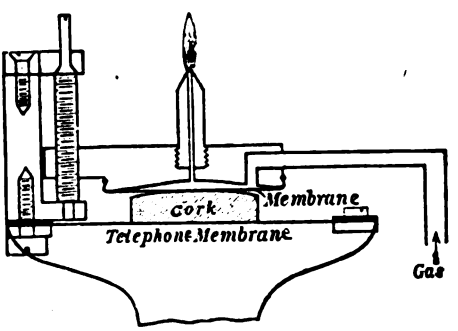

FIG. 19.

us to distinguish this shifting as soon as the telephone is taken from the first point and connected in at the second. The mark will no longer be upon the crest, but at another point in the curve, and its position makes the shifting of the phase a matter of easy computation. When the telephone is moved, a corresponding resistance is inserted in its stead, so that the conditions of the circuit may remain the same. Fig. 24*b* shows it shifted sixty-four degrees. This shifting of phase is due to a cable of 5.5 microfarad capacity and 400 ohms resistance. Further on, other curve diagrams will be presented.

4. In the German Telegraph Engineering Bureau the amplitude of a vibrating telephone diagram was determined in the following manner by means of interferance bands of light.

The mouthpiece was removed from a Siemens telephone, the diaphragm covered with soot, and a microscopist's "cover-glass" fastened to its center. Upon three screws projecting thru the rim of the brass frame F (Fig. 25), rested a ground-glass plate 100 mm. (4 inches) in diameter and 10 mm. (⅜ inches) in thickness. The screws were so adjusted that between the cover glass and the glass plate there remained a space of several tenths of a mm., and the lower sur-

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face of the glass plate was as nearly parallel as possible to the upper surface of the cover glass. Between these surfaces interference bands were produced by a sodium flame whose rays were projected at an angle of forty-five degrees. The bands could be observed with magnifying glass or with the naked eye. A change of distance between the reflecting surfaces shifted the position of the bands. When the diaphragm was thrown into rapid vibration by an alternating current, the bands were also rapidly thrown hither and thither, became indistinct and finally disappeared as the current increased. Disappearance ensues as soon as the shifting amounts to half the width of a band at every motion of the telephone diaphragm, for then the dark and the light bands appear alternately upon the same spot. If the distance between the reflecting surfaces be designated by d, the angle of incidence by a and the wave length of the sodium light by h, then the difference between the paths of two interfering rays will be $ABCDE$ and A^1DE (compare

$$BC + CD = \frac{2d}{\cos a}$$

Fig. 26) and we shall have a shifting amounting to half a band as soon as this value is changed by half a wave length of the sodium light, that is, when

$$\frac{2(d^1 - d^2)}{\cos a} = \frac{h}{2}$$

Accordingly the bands must disappear when the distance of the extreme motion of the middle of the diaphragm is

$$d^1 - d^2 = \frac{h}{4} \cos a$$

or when the amplitude of the diaphragm is

$$A = \frac{h}{8} = \cos a = \frac{589}{8}.10^{-6}.\cos 45° = 52.10^{-6} mm.$$

An alternating current whose strength was varied by cutting in resistances was sent thru the telephone, and the strength of the current so regulated as to cause the bands to disappear. The amplitude of the telephone diagram then amounted to 52.10^{-6} mm. and the strength of the current was found to be $3.4.10^{-4}$ amp. A second telephone (not modified), connected in with the first, with this current produced a loud tone which was distinctly audible several centimeters away, so that in actual use the amplitude of the diaphragm is considerably less than the computed value.

The force of the current waves necessary for telephone operation has been frequently determined. The result is, however, a purely relative conception. If you desire merely to reduce sound with the telephone, it is well known that its sensitiveness is amazing.

By a number of scientists, Ferraris, Warren de la Rue, Pallat, Rayleigh, Preece, the minimum strength of current requisite for operating a telephone has been, with very small variation, found to be 10^{-12} amp., and Pallat has computed that for generating the necessary electricity, the force brought into operation would raise the temperature of 1 kg. of water only 1° Cent. With this slight amount of energy, accordingly, sound can be produced in the telephone during ten thousand years.

But it must be noted that this force is not adequate to give the diaphragm the initial motion. To do this, many mutually auxiliary impulses are needed prior even to any audible sound. After that, the force mentioned above has only the task of overcoming frictional resistance and of maintaining the motion of the

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diaphragm, whose elastic properties also play a considerable part. Ferraris, therefore, finds that the current needed to affect the telephone increases rapidly with the pitch of the tone, so that, within certain limits, it appears to be proportional to the square of the period of vibration. Let m indicate the number of vibrations per second, i the strength in amperes of the current necessary for speaking; then we shall have, according to Ferraris:

	c^3	f^3	a^3	c^4	d^4
n	264	352	440	523	594
$10.^{12}\, i$ Amp	2306	1704	965	656	531
$10.^{6}\, i.n.^2$	161	211	187	183	187

The figures in the last line are the products of the strength of the current and the square of the number of vibrations, and are approximately constant. Rayleigh's later results show values from 100 to 1,000 times lower.

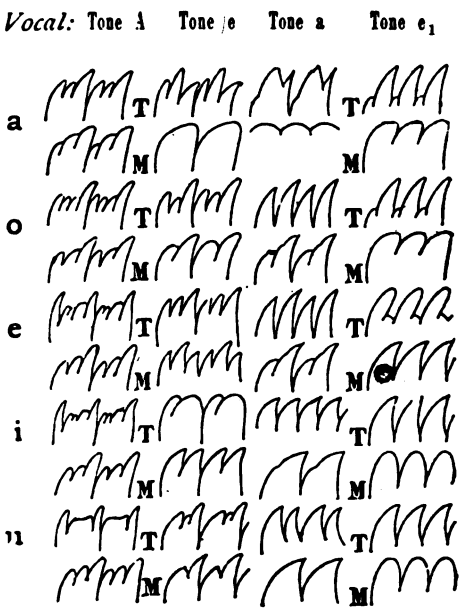

FIG. 20.

For actual telephoning incomparably stronger currents are indispensable, as the diaphragm must accurately reproduce each individual impulse, and there can be no such thing as an accumulation of impulses for any considerable period of time. Distinct transmission under ordinary circumstances demands, as determined by C. R. Cross, A. S. Williams and the writer, a mean amplitude of 0.1 milliampere, that is, about one thousand million times more than the minimum found by the scientists. We have here undoubtedly a remarkable and very instructive instance of the great power of accumulated small forces. On the other hand, it is also shown how identically the same thing may appear in entirely different aspects when regarded from different standpoints.

(To be continued.)

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MONTHLY DIGEST OF TELEPHONE AND KINDRED PATENTS.

EDITED BY CLARENCE C. BROWN.

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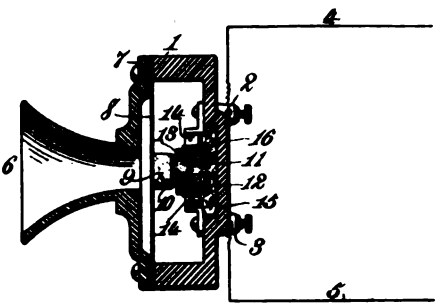
TELEPHONE TRANSMITTER.—MORRIS C. MENGIS, OF BROOKLYN, NEW YORK. Patented September 10, 1901. No. 682,333.

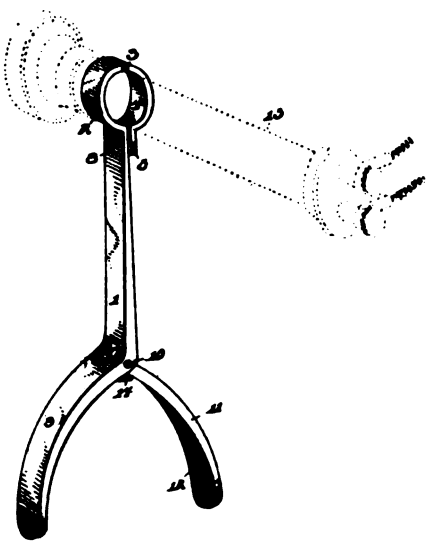
Another form of telephone transmitter, in which there is fastened to diaphragm a conical piece of conducting material which is held in a like cavity.



No. 682,333.

The vibrations increasing or diminishing the resistance. The drawing illustrates it fully.

TELEPHONE RECEIVER.—SAMUEL J. FRIEDMAN, OF MCKEESPORT, PENNSYLVANIA. Patented September 24, 1901. No. 683,266.



No. 683,269.

This is another form of receiver holder. The method of holding the receiver may be clearly seen in the drawing.

SUPERVISORY SIGNAL FOR TELEPHONE SYSTEMS.—FRANK R. MCBERTY, OF DOWNER'S GROVE, ILLINOIS. Patented September 17, 1901. No. 682,732.

The special mode of operation which forms the object of this invention is attained thru the agency of batteries *t*, *u*, *v* and *w*, with their associated switches and local circuits. The polarity of the battery *v* or *w* is adapted to the normal condition of the line with which it is associated, being of one direction in case of a line normally closed, but open during the use of the telephone, and in another direction in case of a line normally open, but closed during the use of the telephone. The batteries are designed to coöperate with the batteries *t* and *u*, temporarily associated with the lines during connection, to insure the illumination of supervisory signals *p* and *p'* at the proper times without respect to the special character of the line with which the signal happens to be associated.

Referring again to the figure, the positive pole of battery *t* is connected to ground, while the negative pole of the equal battery *u* is grounded. The negative pole of battery *v* is connected to earth, and the positive pole of battery *w* is similarly connected. The batteries *u* and *t* should be of sufficient strength to excite the cut-off relay *d*, whether opposed by battery *v* or *w* or not; but when thus opposed one of them should have an electromotive force sufficient to light the signal lamp *p* or *p'*. Batteries *t* and *u* may be of six volts electromotive force and batteries *v* and *w* of four volts. Then the lamps *p* and *p'* should require ten volts on the circuit thru them for their full illumination, the potential available at the lamp terminals being determined by the relation between the resistance of the lamps and that of the magnet of cut-off relay *d*.

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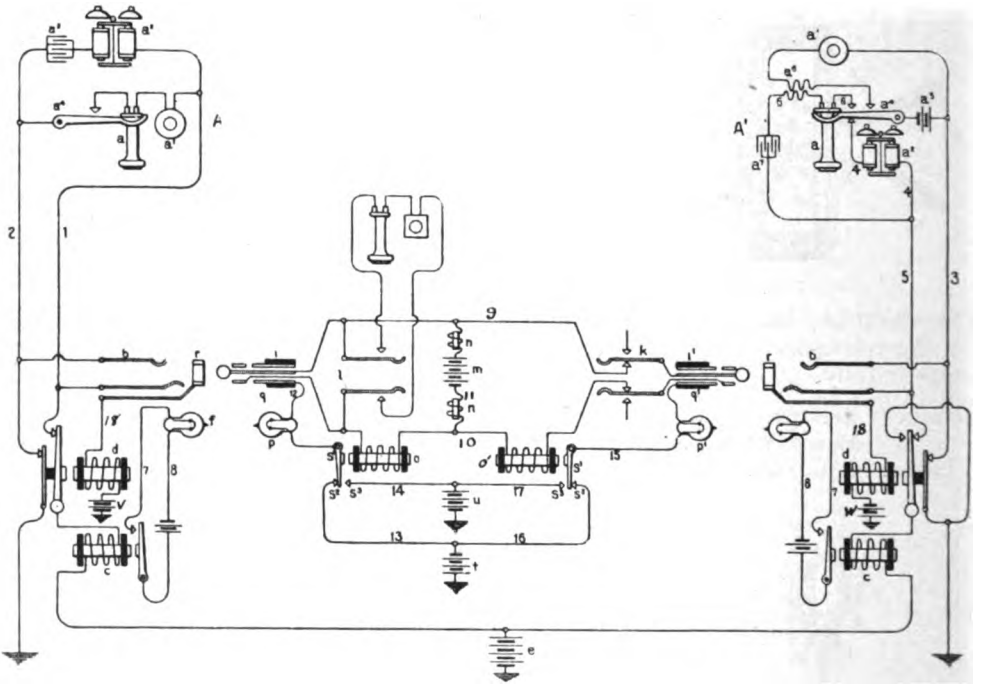
In the normal condition of the appliances described the telephone at station A is on its switch, the line circuit is broken at the substation, so that the relay *c* is inert, and the circuit of the secondary line signal is open. At station A′, on the contrary, the line circuit is closed, being complete from battery *e* over line conductor 5, thru bell a^2, and the local storage battery a^5 to line-wire 3, and thence to earth at the central office. The local storage battery a^5 is thus subject to a continuous charging current from the central battery *e*. The line relay *c* of line to station A′ is constantly excited and holds its armature away from the normal resting stop, maintaining a break in the circuit of the secondary line signal.



No. 682,732.

In order to trace the operation of the system, assume that subscriber at station A wishes to communicate with subscriber at station A′. The call initiating subscriber removes his telephone from its switch for use. This act permits current to flow from battery *e* thru the line circuit and to earth at the central office, whereby relay *c* is excited and lights the secondary line signal *f* to indicate the call. Responding to the call an operator inserts plug *i* into spring jack *b* of the calling line, at the same time bringing her telephone into connection with the plug circuit. The insertion of the plug into the spring jack brings about an extension of the line conductors 1 and 2 to the conductors 9 and 10 of the plug circuit, whereby the battery *m* is brought into a bridge of the line.

Since the line circuit is closed at the substation, this battery produces a flow of currents in the line which excites the supervisory relay *o* and causes it to attract its armature *s′*. The act of inserting plug *i* into the spring jack *b*, together with the change of position of armature lever *s′*, completes a local circuit made up of conductors 18, 12, and 14, which includes batteries *u* and *v*, together with the supervisory signal *p* and the cut-off relay *d*. The resultant electromotive force in this circuit is sufficient to excite the cut-off relay *d* and cause it to sever the normal extensions of the line conductors to the re-

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lay *c* and battery and to earth, respectively, but is insufficient to light the lamp *p*. Hence the act of making connection with the calling line effaces the signal of the line lamp and at the same time renders the supervisory lamp inert. Having learned the order of the calling subscriber for connection with line to station A the operator inserts plug *i'* into spring jack *b* of that line and rings the bell a^2 at the station by means of calling key *g*. The insertion of plug *i'* into spring jack *b* brings the two line circuits into complete metallic connection thru the agency of plug circuit 9 and 10. While the line circuit remains completed by the telephone switch at the substation, current from battery *m* flows to the line and excites the supervisory relay *o'*, whereby its armature is attracted against the contact s^3. A local circuit associated with the line to station A' is thus completed, comprising conductors 18, 15 and 17, and containing the cut-off relay *d* of the called line, the supervisory signal lamp *p'*, and the two batteries *u* and *w*. It will be noted that the polarity of these two batteries is in the same direction in the circuit, so that the resultant electromotive force is ten volts. This is sufficient to operate the cut-off relay *d*, severing the normal earth connections of the called line, and also to light the lamp *p'*. The severance of the earth connections by the cut-off relay is attended with the closing of a local circuit of battery *e* thru relay *c* of the called line, whereby the interruption of the circuit 7 and 8 is maintained and the display of the line signal is prevented. The removal of the telephone from its switch at the called station in response to the call breaks the normally complete circuit of the line and leaves it open at the condenser a^7 as to currents from constant sources of electromotive force. This deprives the supervisory relay *o'* of current, and the relay releases its armature, breaking the connection of wire 15 with wire 17 and closing it to wire 16. The battery *t* is thus introduced into the local circuit in the opposite direction to battery *u*, so that the resultant electromotive force in the local circuit is now but two volts, which maintains the excitement of cut-off relay *d*, but is insufficient to light the supervisory lamp *p'*. The extinction of lamp *p'* therefore indicated to the operator the taking of the telephone for use at the called station. If during the existence of the connection the subscriber at station A should replace his telephone on its switch, thereby breaking the telephone line, relay *o* would be deprived of current and would break the connection between wires 12 and 14, completing it between wires 12 and 13, and thus introducing the battery *t* into the local circuit 13, 12, 18, in proper direction to light the supervisory lamp *p*. A similar act on the part of subscriber at station A' would cause the illumination of lamp *p'* in the mode already traced in considering the establishment of connection with the called line. Hence the replacement of the telephone on its switch at either station lights the supervisory lamp temporarily associated with the line to that station, while the taking of the telephone for use extinguishes the lamp. The replacement of both telephones resulting in the lighting of both lamps *p* and *p'* may be considered a call for disconnection to be followed by the removal of the plugs from the spring jacks of the united lines. Obviously plugs *i* and *i'* might be used in making connection between two stations equipped like station A for direct current supply to the transmitting telephones or between two stations equipped like station A' for local supply to the telephones. In the former case both supervisory signals *p* and *p'* would be operative in the way traced for signal *p*, which was in connection with such a line. In the latter case both supervisory signals would operate in the way described for signal *p'* in connection with line to station A'. In short the operation of the supervisory signals which come into temporary association with both normally closed and normally open lines is the same for both cases and in uniform thruout the switchboard, the different modes of controlling the signals in the different cases being compensated for by special appliances, each adapted for the particular line with which it is connected, this operation simplifying each connection.

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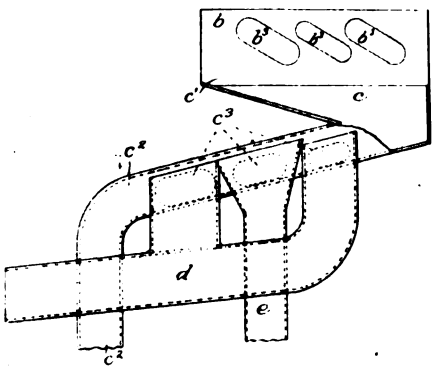
TELEPHONE TOLL APPARATUS.—WILLIAM GRAY, OF HARTFORD, CONNECTICUT, ASSIGNOR TO THE GRAY TELEPHONE PAY STATION COMPANY. Patented September 17, 1901. No. 682,986.

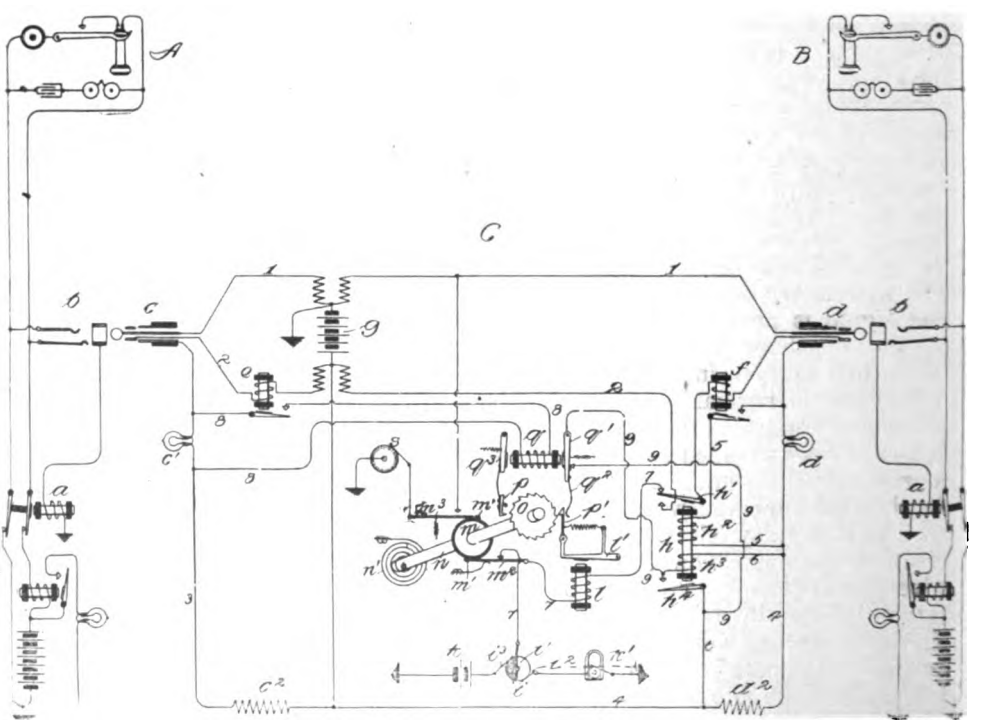
A telephone pay station which is arranged with three slots for three coins of different denominations, and provides against mistake. That is, if a coin of a smaller size than is intended for one slot be dropped, it falls into trough D, and is returned to the subscriber. The method may be clearly seen in the accompanying illustration.



No. 683,986.

AUTOMATIC SIGNALING SYSTEM FOR TELEPHONE EXCHANGES.—JAMES L. MCQUARRIE, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY. Patented October 1, 1901. No. 683,569.

With telephone exchange systems at present in use the operator finds it necessary to ring the called party a definite number of times or a definite length of time, and if no response is had she must connect her telephone with the calling line and report to the calling subscriber that no answer has been made to her signal. Usually the calling party asks that the subscriber wanted be rung again, and this requires the operator's further attention and time and uses her telephone. The present invention is for the purpose of relieving her of this work by providing a contrivance for automatically ringing the subscriber a definite length of time and then automatically reporting to the calling subscriber that no response is obtained from the



No. 683,569.

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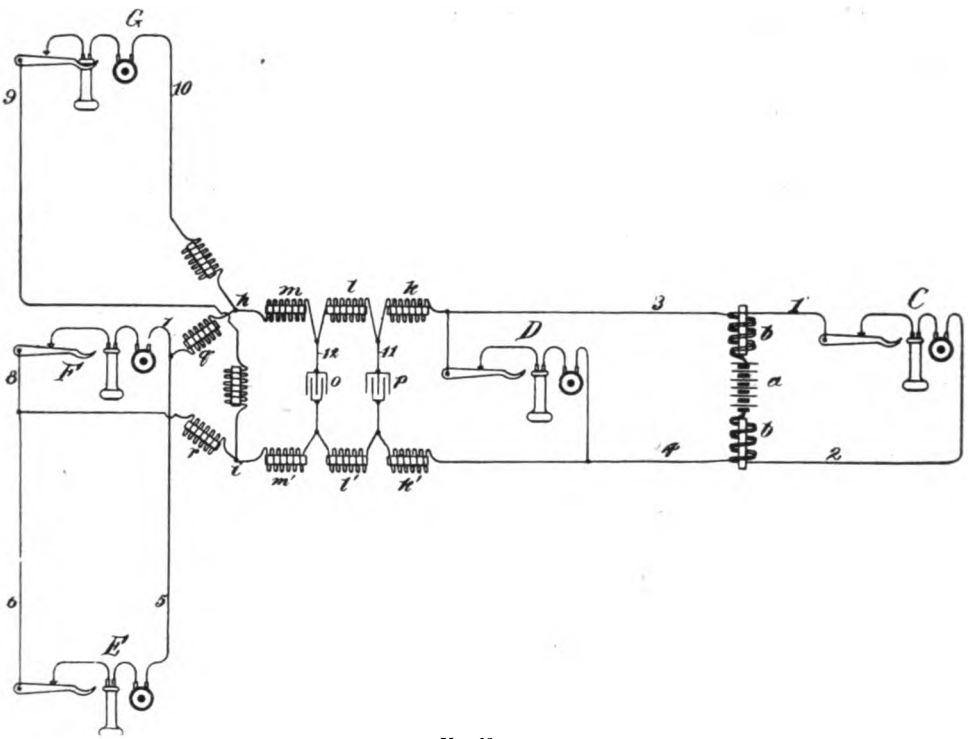
called station, the only work required of the operator being the insertion of the calling plug in the jack of the called line.

The invention may be generally described as comprising a source of peculiar or characteristic signaling current (which may be a phonograph transmitter, or the like), a switch for connecting the same with the calling line, a hears after a given time either spoken words from a phonograph, such as "They don't answer," or a peculiar hum or tone, which he recognizes as meaning that the called party has not responded. He will then hang up his telephone, and the usual supervisory signal lamp at the central office will be lighted, giving the operator the signal to disconnect.



No. 683,505.

time device operated or set in operation during the application of ringing current to the called line, and means controlled by the time device for actuating said switch. In the preferred embodiment of my invention the ringing current is periodically interrupted, and an electromagnetic step by step device responsive to the intermittently applied ringing current advances a predetermined number of steps and then actuates a switch which disconnects the ringing current from the called line and connects the peculiar signaling current with the calling line. The calling subscriber listening in his telephone thus

TELEPHONE CIRCUIT.—CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY. Patented October 1, 1901. No. 683,505.

This invention concerns the prevention of the propagation of alternating or pulsating current thru continuous conductors, its object being to permit the junction of different circles conveying such currents while maintaining the independence of the circuits with respect to the alternating or pulsating currents, or, so to speak, "localizing" the variations of the currents in the respective circuits. It is addressed particularly to telephone circuits which are united

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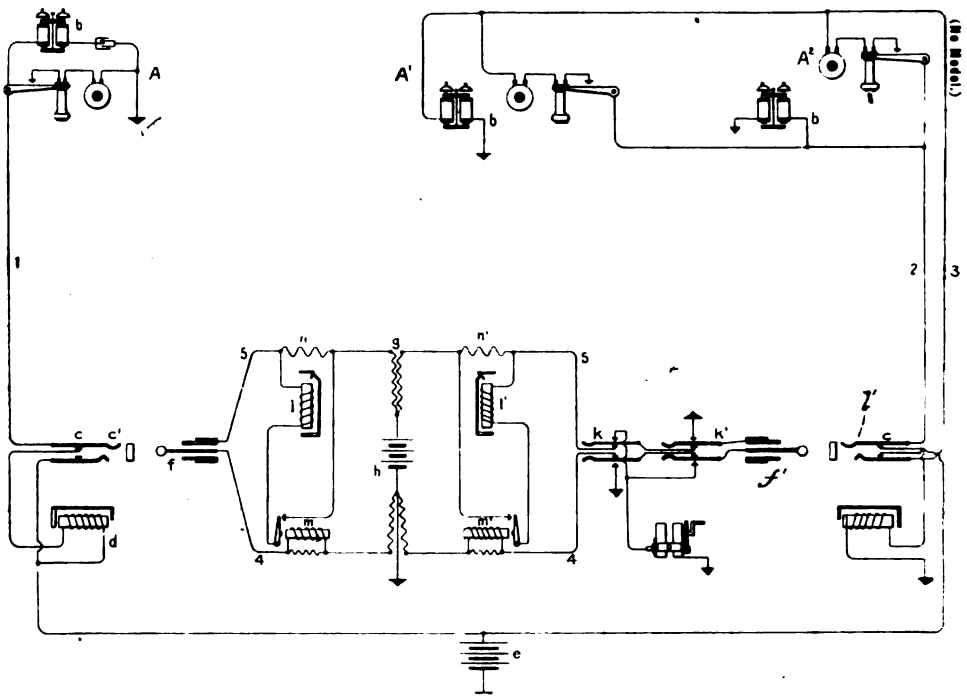
for the transmission of signals or for the supply of current for exciting transmitters, but of which the independence from one another must be maintained to prevent cross-talk.

The particular application of the invention mentioned is illustrated diagrammatically in the attached drawing. Therein a main telephone line, which may be considered as extending thru a telephone central station or other point at which the source of current supply is located and at one terminal to a secondary center, from which several extension telephone lines radiate.



No. 683,480.

Supervisory Signal for Telephone Switchboards.— Frank R. McBerty, of Evanston, Illinois, and James McQuarrie, of Chicago, Illinois, Assignors to the Western Electric Company. Patented October 1, 1901. No. 683,480.

This invention consists in the combination, with the link conductors, of an electromagnetic signal in the path of current to one of the line conductors of a grounded metallic circuit with which the link conductor may be associated, a relay in the path of current to the other line conductor, a single source of current in the link conductors adapted to traverse in series the electromagnets of both these appliances, the circuit thereof being controlled at the substation thru a telephone switch closing a bridge of the line in the use of the telephone, and circuit connections of the relay with the electromagnetic signal, whereby the relay controls and modifies the action of the signal.

The invention is illustrated in the attached drawing.

The drawing represents diagrammatically two telephone lines of usual equipment for the operation of automatic signals, with a single pair of plugs and their associated plug circuit for uniting lines in a switchboard, the plug circuit being provided with our improved supervising apparatus. One of the lines represented is a metallic circuit party line having ground branches and the other is a grounded line.

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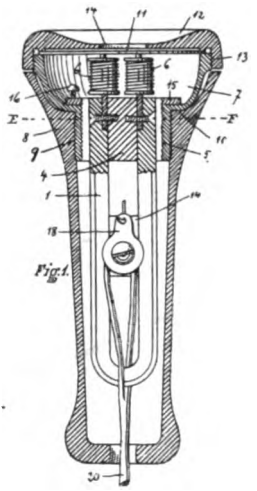
TELEPHONE RECEIVER.—HUBERT LAWRENCE WHITE, OF UTICA, NEW YORK. Patented October 1, 1901. No. 683,631.

In this receiver the magnet and bobbins are held by a threaded collar to the cup; the cup in turn fitting against the

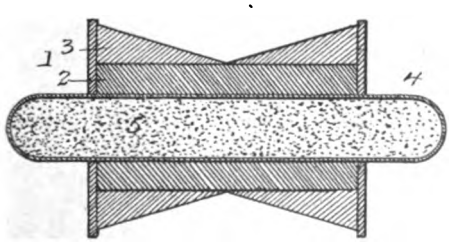


No. 683,631.

rubber shell. By this method it is claimed a receiver may be made cheaper and more easily adjusted. The drawing is a diagrammatic view of the same.

TELEPHONE TRANSFORMER.—HANS LIEBREICH, OF DETROIT, MICHIGAN, ASSIGNOR TO FREDERICK ROHNERT. Patented October 8, 1901. No. 683,954.

This invention consists of an arrangement comprising one or more induction coils, each having a primary and sec-



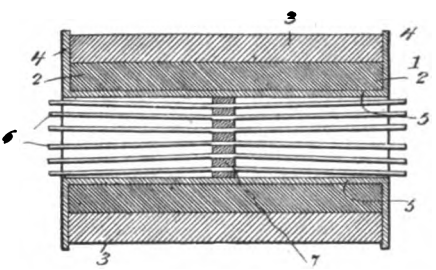
No. 683,954.

ondary winding, cores mounted within the coils and formed of casings filled with comminuted iron fillings or dust, and bars connecting the ends of the cores outside the coils, and means for connecting the primary winding of the induction coil with transmitting instruments and a source of electrical energy and the secondary coil with receivers.

It further consists in an induction coil made up of primary and secondary windings, the secondary winding being diminished in resistance opposite its neutral point, a core for the said coil made up of a hollow casing, a filling of iron dust, and short sections of small iron wires compressed under hydraulic pressure to form a solid mass, bars connecting the ends of the said cores formed of hollow casings also filled with compressed iron dust and short iron rods, and means for connecting the induction coil with the rod.

TELEPHONE TRANSFORMER.—HANS LIEBREICH, OF DETROIT, MICHIGAN, ASSIGNOR TO FREDERICK ROHNERT. Patented October 8, 1901. No. 683,953.

This invention differs from the preceding one in the fact that instead of the core being filled with iron filings



No. 683,953.

it consists of leaves of iron, left free at both ends so that they may be drawn up as is explained in the specifications of the following patent.

TELEPHONE TRANSFORMER.—HANS LIEBREICH, OF DETROIT, MICHIGAN, ASSIGNOR TO FREDERICK ROHNERT. Patented October 8, 1901. No. 683,952.

While the inventor does not limit himself to any number of coils or cores, he has, for the sake of illustration of the present invention, shown a pair of coils 1 1, provided with scores 2 2. The coils are preferably mounted upon a base, as 3, each of said coils having a primary winding as 4, and a secondary winding as 5. The primary winding is made of comparatively coarse wire — say about No. 24 — which is well insulated and

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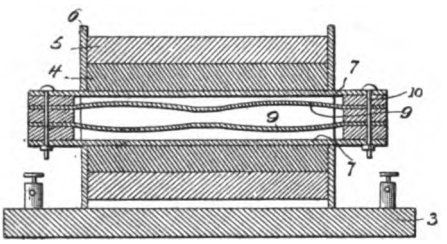
wound in the usual manner, so as to surround the core. The secondary winding 5 is made of wire much smaller in diameter — say about No. 36 — which is suitable for ordinary distances. This wire is insulated and wound about the inner cores 4 4.

Suitable end plates of insulating material, as 6 6, hold the windings in place at the ends of the coils. Thru the



No. 683,952.

center of the coils 4 1 pass a pair of magnetizing plates 7 7, which are somewhat thicker than the laminated plates forming the core proper. These plates 7 7 may be connected up with the core and with the bars 8 8, which join the ends of the cores. The core proper of each coil is formed of a series of thin flexible plates, as 9 9, which are preferably made of soft iron and are secured at their ends to the connecting bars 8 8. While he has shown only two of said plates in the drawings, yet he contemplates using in practice a far greater number, since the efficiency of the instrument and its sensitiveness is much increased by the use of a large number of such plates. A few plates, however, have been shown, so as to better illustrate the manner in which the plates are vibrated and drawn out of their normal position by the action of the primary coils when they are energized. The plates 9 9 are perfectly spaced apart, as shown and 4 of the drawings, and this spacing may be admirably accomplished by forming the bars 8 of a series of thin plates, which bridge between the plates 9 9. Where the bars and the plates join each other, he preferably secures them together by means of a bolt or rivet, as 10. By this arrangement the current may be passed from one coil around thru the bars 8, thru the other coil, and so on. When the primary coil is energized, the opposite ends of the other will be polarized in the usual manner and the plates 9 9 will be drawn near their ends toward said coils as far as their connection with the bars 8 will permit. The central portions of the plates 9 9 will of course not be moved to any great extent, since they are opposite the neutral portions of the coils.

In practice he finds that the movements of the plates 9 9 will produce induced currents in the secondary coils with very high tension, and by connecting the secondary coils with suitable receivers, as 11 11, at the ends of the line the sounds or impulses received thru a suitable transmitter will be greatly magnified and reproduced in telephones and microphones. In connecting up this instrument with a telephone system he preferably places a set of coils so that it may be connected with a transmitter, as 12, of ordinary construction and may also be connected with a battery, as 13, the battery transmitter and primary coil being in the same circuit.

In using an instrument of this kind it is not necessary to connect batteries with the line wires; but the line wire is connected with the secondary coil or coils and the receivers at the ends of the line are also connected with the said secondary coil or coils, one of the wires running from the receivers being secured at its end in the ground by means of a ground plate or other suitable device, as seen at 14 14.

TELEPHONE EXCHANGE APPARATUS AND CIRCUIT.— GEORGE GRABE, OF DEUTSCH-WILMERSDORF, AND LIPA PILINKOWSKY, OF BERLIN, GERMANY, ASSIGNORS TO SIEMENS & HALSKE AKTIENGESELLSCHAFT, OF BERLIN, GERMANY. Patented October 8, 1901. No. 584,366.

This invention relates to telephonic installations with multiple switchboards and parallel branched simple subscribers' jacks; and has for its object, on plugging a subscriber's jack, to put a call signal out of action without the

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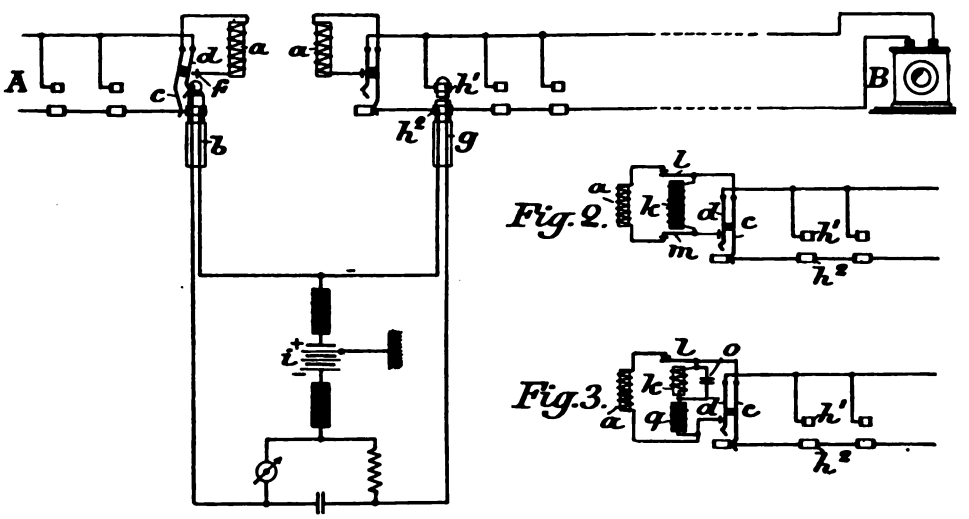
use of special metallic conductors in addition to the metallic line conductors for transmitting the speaking or calling currents, which includes the call signal. According to the present invention this is effected on the plugging of a subscriber's jack by causing the current of a central station battery connected with the plug cords to pass thru that part of one of the simple line-jacks which serves simultaneously as conductor of the speaking current into the line circuit, so as to influence the call signal, either directly or thru the action of a cut-out electromagnet, in such manner that, after the plugging, rent of definite direction into the circuit, the call signal *a* will be released. The operator then introduces in the known manner the answering plug *b* into the answering jack, so that by removing the jack springs *c d* from the jack socket or the contact *f* the call signal is cut off at both poles from the circuit, and the operator then requires the number of the desired substation. By the introduction of the connecting plug *g* into the connecting jack h^1 h^2 of the desired subscriber's circuit B, in which the call signal *a* is still in condition for calling, the speaking connection between the two subscribers thru the plug cable



No. 684,366.

a calling current sent thru the line wire is no longer capable of actuating the call signal.

The illustration shows two subscriber's circuits A and B connected to a central station. In the arrangements shown at Figs. 2 and 3, on the other hand, there are only shown those parts of the arrangements which differ from that shown in the first example in respect of the present invention. In the arrangement shown the call signal magnets *a a'* are polarized for producing the desired effect. When the subscriber connected to circuit A for the purpose of calling the central station sends an alternating current or a continuous current is established, and at the same time a central station battery *i*, which is connected bridgewise with the plug cable and which in the case under consideration serves simultaneously as a testing and closing signal battery, is connected to the circuit of the desired subscriber. The current from this battery passes thru the windings of the call signal magnet *a* in such direction that the polarity thereof is increased. This increase of the polarity of the call signal magnet has the effect that a calling current, which is sent thru the line circuit while the latter is plugged, is not sufficient to release or bring into action the call signal.

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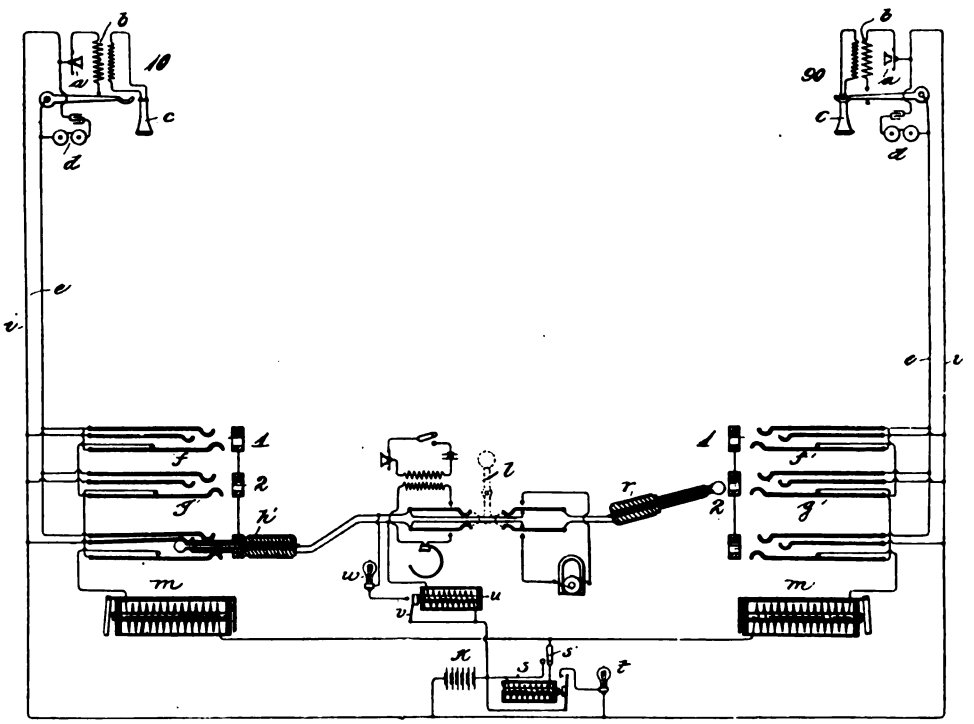
TELEPHONE EXCHANGE SYSTEM.—WILLIAM E. MCCORMICK, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY. Patented October 8, 1901. No. 683,969.

This invention provides a means for operating signals from the subscriber's end. The same signals may be used for a clear-out signal. Heretofore difficulty has been experienced in providing a suitable automatically operated clearing-out indicator. Signaling lamps constitute the preferred form of clearing-out indicators; but I do not wish to be limited to this precise instrumentality. In order to have the signaling lamp glow when connected, subscribers have replaced their receivers upon the switch hooks. It has been proposed to provide, in connection with each clearing-out lamp, a relay, which partly controls a local circuit including the lamp, the relay when deënergized serving to bring contacts in the said local circuit together, a plug seat switch being also employed for controlling contacts included in the said local circuit which are separated thru the agency of a plug when seated to prevent the local circuit from being closed when the cord circuit is idle, to cause the signal lamp to glow or other suitable instrumentality to be operated upon the replacement of receivers upon their switch hooks without having to employ a plug seat switch normally to open the circuit, including the said signal, when the cord connecting apparatus is not in use. To this end in the preferred embodiment of my invention I include a signaling lamp in a circuit, the continuity of which is jointing controlled by a relay, a line jack, and a plug adapted for insertion with the jack. The said relay in the preferred embodiment of the invention when deënergized closes contacts included in the lamp circuit, and if the cord-connecting apparatus is idle the lamp circuit is incomplete, as it depends partly for its completion upon the engagement of a plug with a line jack, so that normally the lamp will not glow:



No. 683,969.

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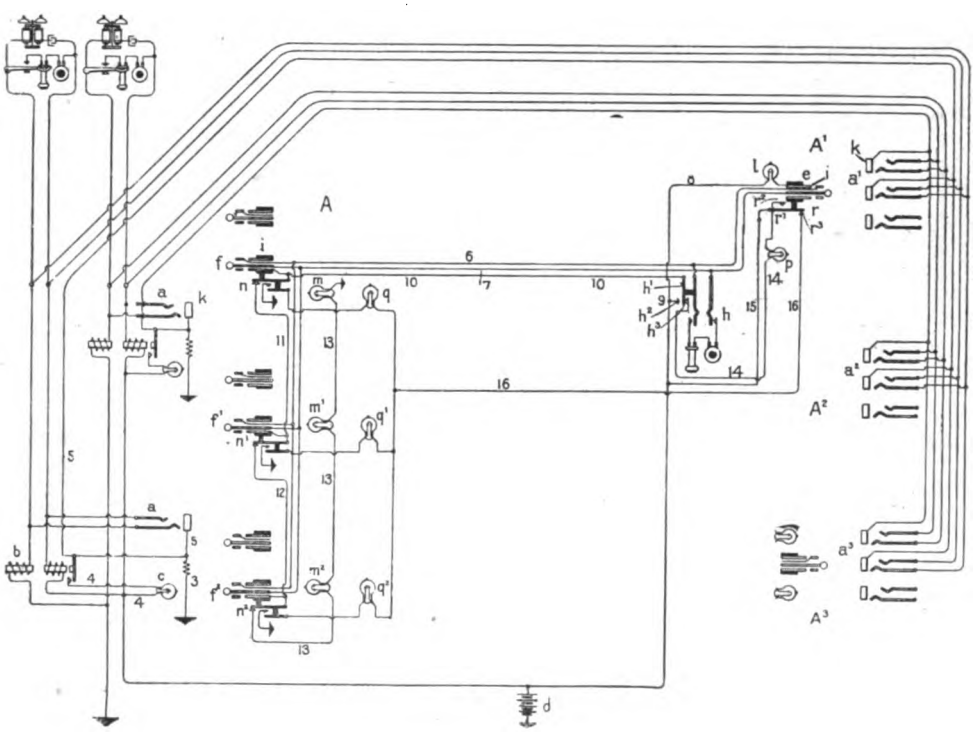
but if the cord-connecting apparatus is in circuit between the lines the lamp will glow if the relay is deënergized, which occurs when both subscribers are thru conversation, they having replaced their receivers upon the telephone hooks to open or render ineffective the circuit including the relay. The signal lamp does not glow when either of the telephones is removed from its hook, so that no clearing-out signal can be manifested unless both subscribers have finished.



No. 684,289.

SIGNAL FOR TELEPHONE SWITCHING SYSTEMS. FRANK R. MCBERTY, OF EVANSTON, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS. Patented October 8, 1901. No. 684,289.

This invention concerns the type of switching system for telephone exchanges known as the "call distributing" system, and has for its object to prevent interference between different call-distributing operators.

This system referred to comprises an annunciator or distributing board wherein are located call-indicating instruments for all the lines entering the central office and switchboards, preferably of the multiple type, in each of which are spring jacks or terminals of all the lines and trunk or transfer lines from the annunciator board to each of the multiple boards, with means for connecting one terminal of the trunk line with any line of the annunciator board and the other terminal of the same trunk line with any line in a section of the multiple board. A call from a station is observed at the annunciator board and thereupon the line is extended by the operator at the annunciator board, thru the agency of a trunk line to any operator at the multiple board who may happen to be free to make next connections, the object of that process being to attain even distribution of the work of switching lines into connection among the different operators at the multiple board. There will of course be as many distributing operators at the annunciator board as may be necessary

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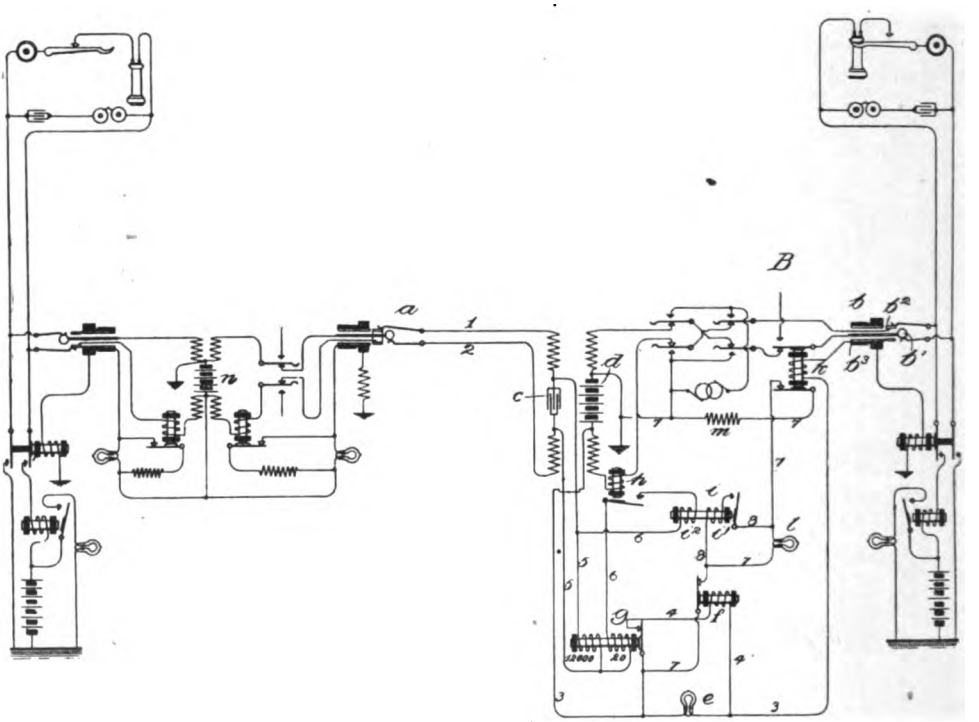
to transfer the calls to the operators at the multiple boards and as many of these latter operators as may be necessary to complete and supervise the connections.

When there are several distributing operators, it is essential to the efficient operation of the system that each of the distributing operators have access to trunk lines to all the switching operators. To this end it is desirable that trunk lines or transfer lines to each of the switching operators shall appear in



No. 684,194.

the multiple terminals at the distributing board, one for each line before each distributing operator. It is to this feature of the call-distributing system that the present invention applies.

SIGNAL FOR TELEPHONE TRUNK LINES.—HENRY M. CRANE, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS. Patented October 8, 1901. No. 684,194.

This invention relates to telephone trunk lines for extending connections from one switchboard of a telephone exchange system to another; and its object is, in general, to provide a ringing signal at the "trunking" or "receiving" end of a trunk line by which the operator at that end may automatically be informed that the called party requires to be signaled.

LOCK-OUT DEVICE FOR TELEPHONE SYSTEMS.—ALFRED DURBIN, OF MCCONNELSVILLE, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE UNITED STATES ELECTRIC MANUFACTURING COMPANY, OF BUTLER, PENNSYLVANIA. Patented October 8, 1901. No. 684,202.

This invention relates to lock-out devices for telephone systems, and is shown in the present case as applied to a selector system, to which it is particularly applicable.

The invention has for an object to provide a lock-out device by means of which all parties upon the line except the central office and the subscriber or

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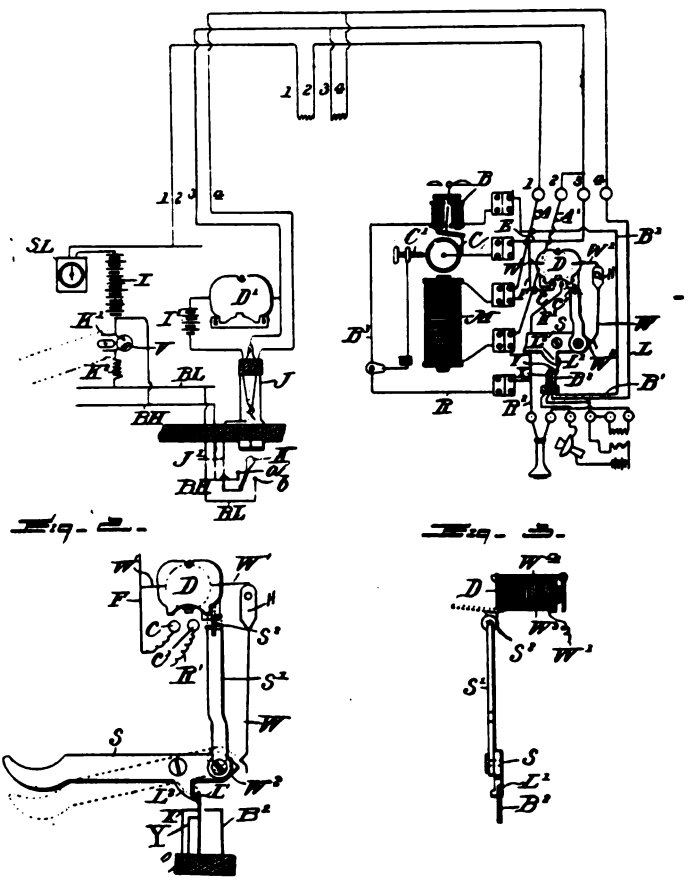
the two connected subscribers are prevented from using the line when the device is operated.

A further object of the invention is to provide means by which the drop comprising the lock-out device may be automatically operated by the regular signaling current on the line and which serves to connect the receiver and transmitter to the line, said drop being automatically restored in the movement of the switch hook when the receiver is placed thereon, and to provide means in connection with a selector system by means of which the contact device in the system may be used as a transmitter of speech when in proper position, thus preventing the closing of the circuit thru any other selector device in a subscriber's telephone which has not been previously set from the central office.

AUTOMATIC LIGHTING SYSTEM FOR TELEPHONE STATIONS.— FREDERICK EDWARD LISTER, OF MINNEAPOLIS, MINNESOTA. Patented October 8, 1901. No. 684,274.

This invention seeks to provide an improved light controlling device for telephone pay stations, whereby at a minimum cost of maintenance efficient light service will be afforded to the telephone patrons.



No. 684,202.

To accomplish the above ends without interference with the telephone service, it is necessary that the electric lamp which is employed to light the booth be normally cut out of circuit with the local battery or source of electrical energy, that this lamp be lighted in advance of the removal of the telephone receiver from the receiver switch, so as to furnish light by means of which the telephone directory may be read and the call num-

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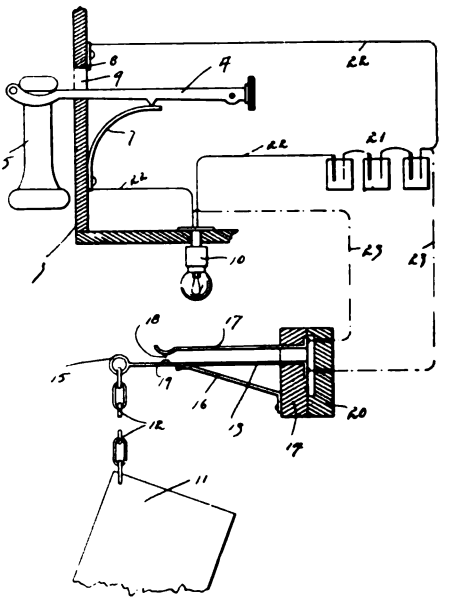
ber ascertained, and it is also very important that after the directory has been used the light from the lamp be continued while the person is using the telephone to call central, to deposit the coin, and to complete the conversation with the person called.

TELEPHONE EXCHANGE APPARATUS.—CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS. Patented October 8, 1901. No. 684,317.

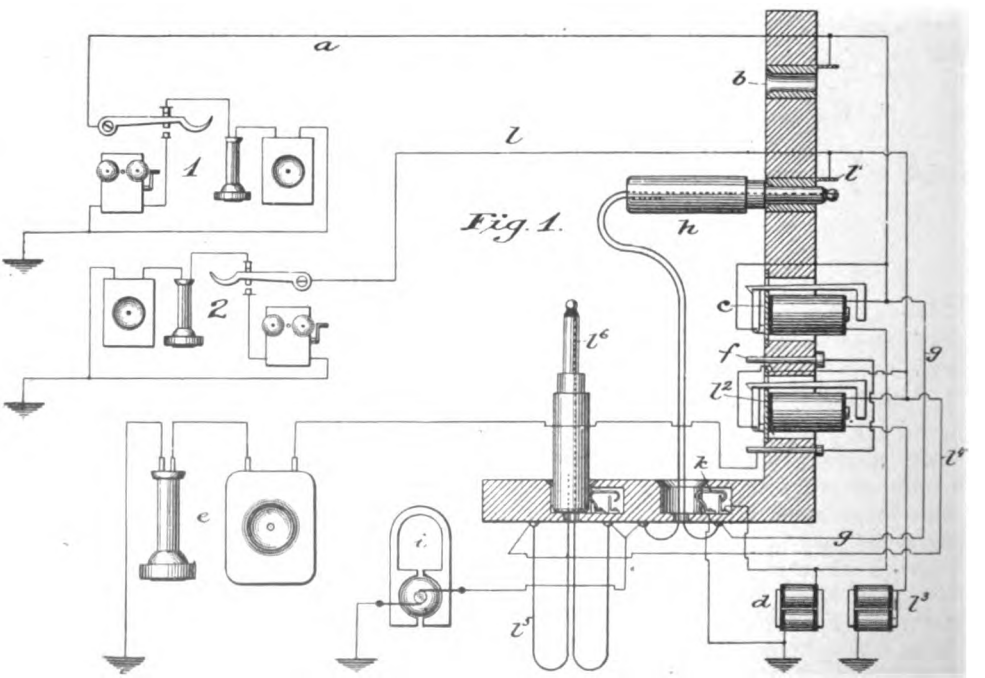
This invention relates to telephone exchange apparatus; and its object is to simplify the apparatus, and thereby prevent accidental interruptions of the circuits, which have heretofore sometimes resulted from the use of the more complicated switching apparatus.

Telephone line *a* extends normally from ground at station 1 to the generator and bell to the switch and thence to the socket *b* of the switchboard and thence thru the individual annunciator *c* and the retardation coil *d* to ground. The operator's telephone *e* is included in a normally open ground branch. When the shutter of the annunciator *c* is thrown down, the line is connected with



No. 684,274.

the telephone at contact *f* in a well known way. The branch *g* from between the socket *b* and annunciator *c* extends to the sleeve of the terminal plug *h*. The alternating current generator *i* is provided with a branch connecting to



No. 684,317.

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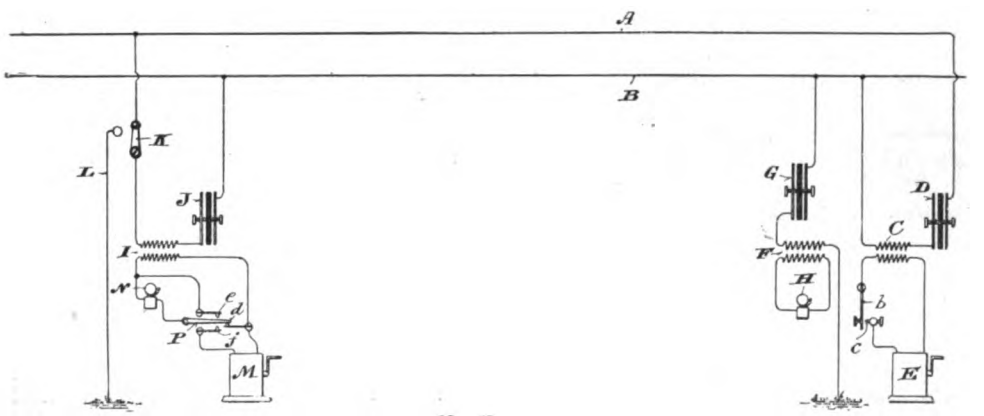
the strand of the cord of plug *h* leading to the tip of the plug thereof. A key *k* is so placed in connection with the socket of plug that when the plug is in its socket the shunt around the retardation coil *d* will be opened, and when the plug is lifted from its socket this shunt will be closed to cut out the retardation coil, so that the individual annunciator *c* may be operative to serve as a clearing-out annunciator. Telephone line 1 is connected in a similar manner from ground at its station 2 to socket 1^1 and thence thru individual annunciator 1^2 and thru its retardation coil 1^3 to generator *i* is connected with the tip of plug *h*, and hence current will be sent over line 1 to ground at station 2, it being understood that the telephone of station 2 is on the hook. When the tip of the plug is thus applied, no appreciable current will be sent to ground thru retardation coil 1^3, and hence the annunciator 1^2 will not be thrown down. The operator having thus called subscriber 2 inserts plug *h* into the socket 1^1, as shown, thus connecting said line 1 with line *a* thru the strand on branch *g*. The individual annunciators *c* and 1^2 of the two lines will remain connected



No. 684,303.

ground. A branch 1^4 extends from between the socket 1^1 and annunciator 1^2 of line 1, to the strand 1^5 of the cord of plug 1^6.

Suppose subscriber 1 wishes a connection with subscriber 2. The telephone at station 1 being on the switch, subscriber 1 turns his generator, sending current over line *a* thru individual annunciator *c* to ground thru retardation coil *d*. The shutter of annunciator *c* being thus thrown down upon telephone contact *f*, the operator listening at telephone *e* will answer subscriber 1 and take his order. The operator will then lift plug *h* from its socket, thus automatically closing the shunt around retardation coil *d* to make annunciator *c* operative and having raised the plug *h* from its socket, will touch the tip thereof to connecting socket 1^1 of line 1. Now, as before stated, the alternating current in their ground branches. Since the retardation coil *d* is shunted, individual annunciator *c* may serve as a clearing-out signal.

ELECTRIC TELEPHONE SYSTEM.—WILLIAM E. PEMBLETON, OF WITTENBERG, WISCONSIN. Patented November 8, 1901. No. 684,303.

This invention has for its object to eliminate resistance of the coils of call signal magnetos from talking circuits of electric telephone systems, and it consists in what is hereafter particularly set forth with reference to the accompanying drawings and subsequently claimed.

The drawing is a diagram illustrating an application of this invention.

Referring by letter to the drawing, A D indicate a pair of parallel conductors constituting the line of an electric telephone system to which this in-

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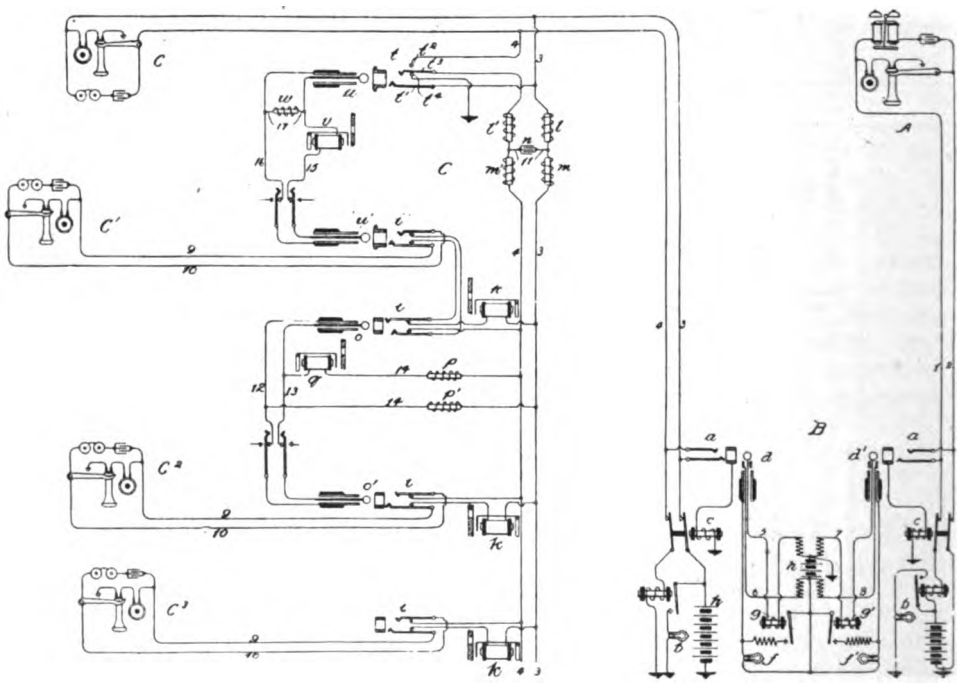
vention is applicable. Between the conductors all the telephones on the line are bridged in the usual manner, normally in open circuit. At a central station on the line the secondary of an induction coil C is bridged between the conductors aforesaid by an electric resonator D, and in normally open circuit with the primary of said coil are a magneto E, a spring contact plate *b*, and an adjustable contact point *c*, these contacts serving as means for making and breaking the circuit. The resonator is shown as comprising a pair of conductor plates and intermediate insulating plates and opposing conductor screws, these screws being adjustable in all the plates to vary the spark gap, this gap being shown in the sectional illustration of resonator D, constituting part of the central station equipment. At the aforesaid station the secondary of another induction coil F connects conductor B and ground thru an electric resonator G, that is preferably similar in detail to the one above specified, an electric call bell or other electric signaling device being electrically connected to both terminals of the primary of said coil. At each of the substations on the line is an induction coil I, having the secondary thereof in circuit with an electric resonator J and conductors A B, this resonator being preferably similar in detail to those set forth in the foregoing. A switch K is employed to at times cut out conductor A and put a terminal wire L, connected to ground, in closed circuit with the secondary coil I.



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the resonator J and conductor B. The primary of induction coil I is in circuit with a magneto M and an electric call bell N or other electric signaling device, this circuit being normally closed by a switch blade P in touch with a contact point *d*, as herein shown. Spring contacts *e f* are shown arranged in opposite direction from the switch blade P, normally out of touch with same and electrically connected to be in a circuit with magneto M and primary of induction coil I.

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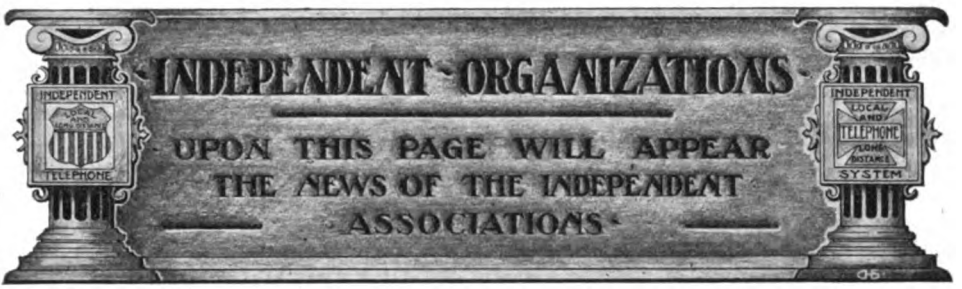

REPORT OF THE FIRST CONVENTION OF THE INDEPENDENT TELEPHONE ASSOCIATION OF MAINE.

Maynard S. Bird, of Rockland, general manager of the Eastern Telephone Company, of Maine, on behalf of his company sent out invitations to all officers of the other Independent telephone companies, large or small, doing business in Maine, to be present at a convention held at Norway, on Saturday, October 19. As the small lines are more numerous in this portion of the State, they had the meeting held at Norway, where the Eastern Company has a new exchange in good running order. They met at the Eastern Exchange, where the appliances and their workings, and various supplies were shown and explained to the representatives from smaller towns.

The following companies were represented:

Eastern Telephone Company.

Oxford County Telephone and Telegraph Company, Sumner.

Bryant's Pond Telephone Company.

Greenwood City Telephone Company.

Richardson Hollow Telephone Company, of Greenwood.

Pine Tree Telephone Company, of New Gloucester.

Casco Telephone Company.

Casco and Naples Telephone Company.

Bolster's Mills Telephone and Telegraph Company.

Sumner and Paris Telephone and Telegraph Company.

Dirigo Telephone Company, of Portland.

Androscoggin and Kennebec Telephone Company, of Wayne.

The following is a partial list of the men in attendance as interested parties: Maynard S. Bird, Rockland; E. Allen, Rockland; George Crocker, Rockland; Nathan C. Pinkham, Bolster's Mill; H. C. Cook, Cook's Mills; Frank H. Noyes, Norway; Samuel T. White, West Paris; George W. Ridon, West Paris; Horace C. Oxnard, Norway; Dr. E. C. Walker, East Waterford; Eugene French, Norway; Harry Wood, Norway; E. F. C. Greene, Norway Lake; E. L. Gay, Bolster's Mills; George Tubbs, Greenwood; Edward W. Penley, West Paris; George Marshall, West Paris; G. W. Q. Perham, Bryant's Pond; H. Alton Bacon, Bryant's Pond; James R. Day, Bryant's Pond; Bertrand G. McIntire, East Waterford; Alvah M. Andrews, South Woodstock; Frank R. Andrews, South Woodstock; Frank E. Davis, South Woodstock; William S. Davis, South Woodstock; C. P. Chandler, New Gloucester; William H. Lurvey, West Paris; Dr. Eugene H. Andrews, West Sumner; Frederick S. Walls, Vinalhaven; Albert D. Park, South Paris; Walter L. Gray, South Paris; Walter S. Buck, Norway; Wellington H. Eastman, East Sumner; William T. Cobb, Rockland; L. M. Tripp, Rockland; F. M. Spear, Rockland; A. Mont. Chase, Bryant's Pond; Albert J. Stearns, Norway; Charles P. Barnes, Norway; Jesse M. Libbey, Mechanic Falls; Sidney M. Bird, Rockland; Howard D. Smith, Norway; Merton L. Kimball, Norway.

The meeting was called to order by Maynard S. Bird, of Rockland, general manager of the Eastern Telephone Com-

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pany, the largest Independent company in New England. He told the story of how his company started, in the efforts of the people of Vinalhaven on Fox Island to get communication with the main land. They finally did it by organizing a company, owning their own line and instruments, and laying a cable under the ocean. Then Rockland people began to ask for connections on the line, and they opened a local exchange in the city. Then the people in neighboring towns asked for a connection and got it. And now they are trying to cover the whole State, with exchanges in the cities and villages. They want to do the long-distance business, but have learned by experience that they can not profitably control the cross-country lines thru farming communities. But to connect with those small lines and furnish them a medium for larger communication is a business which has been found mutually pleasant and profitable. They are building a line from Norway to Lewiston, and expect to go into Portland soon.

C. P. Chandler, of New Gloucester, said that the Pine Tree Telephone Company had been working several years, and doing well, and that they are pleased to have their present connection with the Eastern.

G. W. Q. Perham, of Bryant's Pond, has taken an active part in advocating telephone use by the farmers. He is on a line that has been in use about a year, and has recently been made more valuable by longer connection.

Nathan C. Pinkham announced that the Bolster's Mills line is ready for stringing wire.

Dr. E. H. Andrews, of West Sumner, told about the cross-country lines thru Sumner, Hartford, Buckfield and Turner, and wants them extended thru Hebron, Canton and Rumford.

George Marshall, of West Paris, announced that in the near future a line will be built from Greenwood City to Locke's Mills.

James R. Day, of Woodstock, wants a more convenient connection with the long-distance line.

George F. Crocker, superintendent of inside construction for the Eastern, and L. M. Tripp, superintendent of outside construction for the same company, answered questions about the details of building and maintaining lines.

Hon. Frederick S. Walls, president of the Eastern Company, talked about the advantages of mutual helpfulness.

G. W. Q. Perham was chosen chairman, and Samuel T. White secretary of the meeting, and C. P. Chandler, Maynard S. Bird and Alvah M. Andrews were appointed a nominating committee.

Speeches were made by Albert J. Stearns, Charles P. Barnes, Walter L. Grey, William T. Cobb and Jesse M. Libby.

The committee on nominations recommended the following for officers, who were elected: President, Maynard S. Bird, Rockland; first vice-president, George W. Q. Perham, Bryant's Pond; second vice-president, Lewis A. Goudy, Portland; secretary and treasurer, Samuel T. White, West Paris; executive committee, Nathan C. Pinkham, Bolster's Mills; George W. Richardson, West Paris; J. M. Moulton, Wayne; Eugene H. Andrews, West Sumner; Frank R. Andrews, South Woodstock; H. C. Cook, Cook's; F. E. Davis, South Woodstock.

The Independent Telephone Association of Maine was the name decided on. The officers and executive committee are to encourage formation of new companies and development of new territory, to arrange for the next meeting at such time and place as they see fit, and prepare by-laws for presentation to that meeting.

One thing that was emphasized by nearly all is the necessity for no cheap work or material in constructing lines.

ELECTRIC APPLIANCE COMPANY.

THE Electric Appliance Company, Chicago, has been caught in the act of pointing with pride to their Number 36 Cabinet Type Wall Telephone. It is made in several styles, which are described in circular they are now sending out to the trade. By sending your name and address to us you will receive this circular.

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TELEPHONE NEWS.

ALABAMA.

BIRMINGHAM, ALA.—The Hillman Hotel, just completed, is equipped with a private system of telephones, 240 in number.

CORTLAND, ALA.—An effort is being made to establish a telephone exchange at Cortland, Alabama. Many of the large planters live in town and have no means of communication with their plantations. This, with the business houses, would furnish a sufficient number of subscribers. If the system is established it will have connection with the long-distance telephone.

OPELIKA, ALA.—A long-distance telephone line has been completed from Lafayette to Roanoke, thereby completing a telephone service from Opelika to Roanoke.

CALIFORNIA.

LOS ANGELES, CAL.—The Telephone Hygienic Company has been incorporated; capital stock, $500,000. The incorporators are H. L. Cutter, E. H. Cutter, J. S. Osborn, W. R. Fales and G. J. Leovy.

YUMA, CAL.—Local business men have incorporated the Colorado River Telephone Company, which is designed to bring Yuma into communication with the mining districts that lie to the north and northeast.

CAROLINAS.

KINSTON, N. C.—A new switchboard was recently put in for the local telephone system at Kinston, North Carolina. Howard F. Jones, the general superintendent of the Carolina Telephone Company, is having improvements made over the whole local system with the purpose of giving Kinston a good telephone service.

MOREHEAD CITY, N. C.—The poles for the telephone line between Newbern and Morehead City, North Carolina, are all in place. The placing of the wires will begin at once from the lower end of the line, and will be pushed to completion. The line will prove a valuable factor in the business of that section and will bring into direct communication the various points along the line.

ORANGEBURG, S. C.—Chartered: Orangeburg & St. Matthews Telephone Company, with capital stock of $1,500, by W. H. Dukes, A. C. Andrews and W. C. Wolfe.

RALEIGH, N. C.—The Henderson Telephone Company is putting in a long-distance line between New Bern and Raleigh, North Carolina.

STATESVILLE, N. C.—John W. Kirby, of Marion, North Carolina, has purchased the Statesville (N. C.) telephone exchange. Extensive improvements are contemplated.

DAKOTAS.

ABERDEEN, S. D.—The Dakota Central Telephone Company has increased its capital stock from $100,000 to $500,000. It is rapidly extending its lines to cover the entire State.

COLTON, S. D.—A company has been incorporated with a capital stock of $10,000 for the purpose of putting a telephone system in at the new town of Colton, and also connecting that town with surrounding towns.

KIMBALL, S. D.—At a meeting of those interested in the new telephone company at Kimball, the following were elected as a board of directors: E. P. Ochsner, Dr. A. M. Willy, C. S. Blodgett, A. S. Stuver and H. W. Hinrichs. It is proposed to connect all the principal farms in Brule county with the telephone system at Kimball.

OAKES, N. D.—Oakes is to have a telephone exchange.

DISTRICT OF COLUMBIA.

WASHINGTON, D. C.—The Louisiana & Texas Long Distance Telephone Company, Limited, is reported sold out to the Telephone Company of America, of Washington, D. C., for a consideration of $35,000 cash.

WASHINGTON, D. C.—It is expected that by the first of next month a beginning will be made in the operation of a manufacturing plant in Washington, D. C., that will give employment to some six hundred men. As preliminary to this a real estate transaction has practically been closed, which involves the expenditure for property of something over $200,000.

FLORIDA.

MARIANNA, FLA.—The Marianna Telephone Company, with a capital stock of $5,000, to construct and operate a telephone exchange in the town of Marianna; also to build and operate telephone lines along the public highways and roads in the counties of Jackson, Washington and Calhoun, and to build and operate telephone exchanges in other towns in said counties. The incorporators are W. H. Milton, J. Walter Kehoe and Robert J. Boon.

ILLINOIS.

ALLENTOWN, ILL.—The Independent Telephone Company has completed a line to Allentown.

BLUFFS, ILL.—The directors of the Illinois Telephone Company held a meeting in Bluffs, for the purpose of changing the headquarters of the company from Bluffs to Jacksonville and also to increase the number of directors from six to nine, both of which were decided upon. Those here were Messrs. Henry Ab-

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bott, Naples; A. P. Grout, Winchester; Henry Perbix, A. B. French and J. W. Moody, Chapin; C. F. Tonn and E. S. Greenlief, Jacksonville; John Carpenter, Oxville; J. H. D. Vortman, Neeleyville. The company now has a capital stock of $100,000, over $5,000 of four years ago.

BEARDSTOWN, ILL.—The citizens of this place are agitating the question of a telephone franchise for the Virginia & Little Indian Telephone Company.

BLOOMINGTON, ILL.—A party of Eastern capitalists are in the city negotiating for the purchase of the Home or Independent Telephone Company, which has been in operation here for several years and now has seven hundred instruments in use. The company was organized to secure competition with the Bell, but has never had the money to put in as good service as the Bell. It is said the Home is paying a fine interest. The deal includes the toll lines of the McLean County Telephone Company, which runs to all the towns and villages and many of the private houses in the county. The consideration is not stated.

CHICAGO, ILL.— Mr. William H. Crumb has recently resigned his position as general superintendent of the Pittsburg & Allegheny Telphone Company at Pittsburg, and has opened an office at 1211 Monadnock building, Chicago, for the general practice of telephone engineering and contracting. Mr. Crumb is well known in Chicago and the Middle West on account of the important position he held with the Pittsburg & Allegheny Telephone Company, and also on account of his prior connection with the Central Union Telephone Company, whose headquarters are in Chicago. Mr. Crumb is specially well fitted for the business he has recently undertaken, on account of his wide experience in both the constructive and operative branches of the telephone business, his unquestioned business ability and his previous technical training at Cornell University, from which institution he was graduated in electrical engineering in 1894. All of his friends wish him and predict for him greatest success.

CHICAGO, ILL.— Mr. George L. Wilkinson, for several years a first assistant examiner in the Patent Office, who has successively been the ranking assistant in charge of steam engineering, of railroad devices, of electricity, and latterly law clerk, is associated with Mr. Walter H. Chamberlain.

CHICAGO, ILL.— Mr. Walter H. Chamberlain has resigned the office of Assistant Commissioner of Patents and has resumed the practice of law in this city, where, as in the past, he is making a specialty of patent and trade-mark causes.

CHICAGO, ILL.—About five hundred linemen in the service of the Chicago Telephone Company struck on October 1. Among the towns affected are Elgin, Aurora, Joliet, Rockford, Evanston, La Grange, Plainsfield, Lake Forest, Highland Park and Waukegan.

MARTINSVILLE, ILL.—The Citizens' Telephone Company of this city talks of extending its line to Martinsville.

ELMDEN, ILL.— Mr. Herman Landan has almost completed his telephone line from his residence three miles west of town to the central office in D. L. Bowles & Co.'s store.

GALESBURG, ILL.—The wires for the new telephone lines are being put in thruout the underground pipes. The cables contain 250 copper wires each.

HENRY, ILL.—The Bureau County Independent Telephone Company is building a line between Princeton and Bureau Junction.

HARVARD, ILL.—A. B. Wager, of Woodstock, has sold out his telephone exchange to a syndicate composed of Judge C. H. Donnelly, George W. Field and F. D. Joslyn.

KEWANEE, ILL.— P. O. Norling, secretary of the Globe Automatic Telephone Company, of Chicago, has completed negotiations with the Hayes Pump & Planter Company for the installation of an exchange in the factory. A large extent of the plant makes a private exchange necessary, and the old one has proven inadequate to the demands. The new system will consist of ten instruments of the latest Globe pattern. The connections will all be made automatically, the feature of the Globe 'phone, and no operator will be required.

MANHATTAN, ILL.—The Manhattan Telephone Company, Manhattan, Illinois. Capital stock, $2,400. Incorporators: Benjamin J. Baskerville, Dennis Hogan and August Tennyson.

MORRIS, ILL.—The capital stock of the Bureau County Telephone Companv has been increased to $120,000.

MOLINE, ILL.—The Independent Telephone Company, which is operating in this county and several other counties and seeking entrance into Moline, has reached as far as East Moline, where the line has stopped.

MONMOUTH, ILL.— Charles C. Hook is constructing a telephone line in Warren county for the Independent Company.

NIOTA, ILL.—The Nauvoo-Colusa telephone line is extending its line from the Briley farm in Appanoose township to Niota, which will give them two connections with Niota.

PEKIN, ILL.—The new telephone company in Pekin, Illinois, has begun the work of sinking the trenches for its underground cables there. The cables will be placed in tiling three feet below the surface.

ROCK ISLAND, ILL.—The Rock Island (Ill.) city council is wrestling with the question of two Independent telephone companies, there being a proposition from a Pennsylvania party as well as that of Bills & Wortham. The latter is still pending and is the subject for discussion at a conference of the local interests.

SHEFFIELD, ILL.—The stockholders of the Bureau County Independent Telephone Company have voted to issue $65,000 of new stock, thereby raising the total amount outstanding to $120,000.

TREMONT, ILL.—The Independent Telephone Company is building a line from this place to Dillon.

WENONA, ILL.—At the annual meeting of the Wenona-Magnolia Telephone Company

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the following officers were elected: President, Sanford Lungreen; vice-president, W. H. Parkinson; secretary and treasurer, U. G. McAdam; directors, W. D. Dunlap, Walter Wilson, Perry Griffin, Herbert Beckwith and James Kirkpatrick. It was voted that the Wenona terminus be placed in the Wenona union switchboard.

INDIANA.

BRAZIL, IND.—Mr. James Ferguson, formerly general superintendent of the Municipal Electric Light Company, of Brooklyn, New York, and after the amalgamation superintendent of the Edison Electric Illuminating Company, has accepted the position of general superintendent and consulting engineer of the McRoy Clay Works, Brazil, Indiana. Mr. Ferguson has for years been identified with the electrical interests of Brooklyn, in all lines of construction and operation, and it is safe to say that he will handle the manufacturing of McRoy conduits as capably as he has their installation.

CROWN POINT, IND.—The Crown Point Telephone Company is building its new line between here and Merrillville.

CARTHAGE, IND.—The Carthage Telephone Company has arranged to widen the service given to its subscribers by connecting with the Rushville and Knightstown Telephone Company's wires. This arrangement gives connection to over one thousand subscribers and practically covers the counties of Rush, Henry and Hancock. While this makes 'phones of much more value to subscribers here, the rates will not be raised. An additional switchboard is being placed in the company's central office for the accommodation of the many new subscribers desiring service. The Carthage Company will extend its lines from Occident to Rushville, giving two lines into that city.

FORT WAYNE, IND.—A committee of representative Fort Wayne capitalists, engaged in buying and establishing Independent telephone exchanges in many Indiana towns, returned this morning from Anderson, where they examined the exchange. Negotiations are now on for the purchase of the Anderson system by the Fort Wayne company.

LA FAYETTE, IND.—Capitalists of Chicago, Lafayette, Ind., and Evansville have purchased the District Telegraph plant in this city, and will establish an Independent telephone exchange here, which will become a part of the great Independent telephone system that is growing so strong in the States of Illinois, Kentucky, Indiana and Ohio.

LOGANSPORT, IND.—The Cass County Telephone Company, Logansport. Capital stock, $60,000.

MARION, IND.—The city of Marion has granted permission to the United States Telephone Company to remove its overhead wires in this city and to reëquip its local Independent plant with the underground central energy system.

NEW ALBANY, IND.—The Home Telephone Company, of New Albany, Indiana, has purchased the system at Sellersburg of the Sellersburg Telephone Company, which has over one hundred subscribers.

PERU, IND.—The Home Telephone Company, organized with a capital stock of $40,000 by Jerome Herff, has awarded the contract for the construction of its system in this city to the Jones & Winters Construction Company, of Chicago, and the line is to be ready for use by January 1, 1902.

RILEY, IND.—The Union Telephone Company, a coöperative concern owned by citizens of Riley township, has petitioned the county commissioners for the right to construct a system of telephone lines in Vigo county. The officers of the company are John Schmner, president; Charles M. Lee, vice-president; W. H. Jackson, secretary, and Isaac Kutz, treasurer. The directors are the above officers and J. W. Brunker, William McIntosh, Ed A. Staggs, Ray Lee and C. Cox.

SOUTH WHITLEY, IND.—The South Whitley Telephone Company. Increase of capital stock from $3,000 to $15,000.

ZIONSVILLE, IND.—The Citizens' Telephone Company, capital stock $10,000, has been incorporated.

IOWA.

COLTON, IOWA.—The Colton Telephone Company, at Colton, with a capital stock of $10,000. Incorporators, O. P. Anderson, Martin Larson, A. T. Austin, J. E. Colton and others.

COLUMBUS JUNCTION, IOWA.—A new line running twelve miles toward the northwest has been added to its exchange by the Columbus Junction Telephone Company. of Columbus Junction, Iowa.

DEEP RIVER, IOWA.—There are now four rural telephone lines running into Deep River, and others are in course of construction. The town exchange has forty-four subscribers.

DES MOINES, IOWA.—Articles were filed with the secretary of state by the Woodstock Telephone Company. The capital stock is $5,000. C. H. Clifton is president, M. Walker vice-president, J. C. Smith secretary.

DES MOINES, IOWA.—Farmers and Merchants Mutual Telephone Company; capital stock, $2,000; W. A. McClananhan and others incorporators.

FORT DODGE, IOWA.—The Fort Dodge Telephone Company is making arrangements to put in a new switchboard of the latest design in its office at that place.

GRAND MOUND, IOWA.—The Tri-City Telephone Company has its poles set from DeWitt to this place, and is now working between this place and Calamus with a force of men setting poles.

GRINNELL, IOWA.—The Interior Telephone Company has closed a ten-year lease on the rooms for its new exchange in the Spaulding block and the rooms are being remodeled to suit the convenience of the company.

HAWARDEN, IOWA.—The telephone poles are nearly all set for the new line from Hawarden, Iowa, to Alcester, this State. The line will be in operation soon.

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LANCASTER, IOWA.—The farmers west of Lancaster are putting up a telephone known as the People's 'Phone.

LYMAN, IOWA.—A new telephone line from Stanton to Lyman is being agitated.

LAPORTE CITY, IOWA.—The city council has granted a franchise to Otto Weitstein, Jr., for the erection of a new telephone system in LaPorte City.

MALVIN, IOWA.—At a recent meeting of the board of directors of the Tabor Telephone Company, they decided to give free exchange to their patrons to any point in the county in which they live. This is a great convenience and will doubtless be heartily appreciated.

NORTH LIBERTY, IOWA.—George W. Wagner will organize a rural telephone company at North Liberty to-night which will operate a network of lines in the northwest part of this county, connecting with the exchange of the Johnson County Telephone Company in this city. The meeting will be held in the Hoover school house two miles west of North Liberty.

NEVADA, IOWA.—A number of prominent farmers in Milford township have organized a rural telephone exchange, which is now being constructed.

PROTIVIN, IOWA.—The Protivin Telephone Company, Protivin. Capital stock, $4,000. Incorporators: Frank J. Fenel, John Fenel, Joseph Bouska, Fred Lukes, Frank Kalishek, Albert M. John Kesh, Bouska and John A. Dostal.

SCOTT, IOWA.—A telephone line is talked of from West Branch to the city. The principal houses along the line will connect, if they can raise the price.

SIOUX CITY, IOWA.—John Van Wegnen has returned from a trip to Pierce, Nebraska, where he made arrangements with the town officials to put in a local telephone system. The new Clark automatic switchboard will be used — one of the 75-phone capacity — and the board and poles and other material have been ordered from the East. This system is being put in so that it can be used as an illustration of the practicability and successful operation of the new switchboard.

WEST DULUTH, IOWA.—The Duluth Telephone Company is stringing new wires from West Duluth to Bay View Heights and Proctorknott.

WAVERLY, IOWA.—The Waverly Telephone System has finished laying about 1,500 feet of underground circuit. New switchboards are being put in which will accommodate about 400 patrons, and other improvements are being made. All work will be completed in a short time. The telephone exchange there, now known as the Waverly Telephone System, was, until recently, operated by the Cedar Valley Telephone Company, which sold the exchange to a local company organized in Waverly. Half the stock in the new organization is taken by the Cedar Valley Telephone Company, the rest by citizens of Waverly. The capital stock of the new company is $30,000.

KANSAS.

DE SOTO, KAN.—The De Soto Telephone Company, De Soto, Kansas. Capital stock, $500.

LEAVENWORTH, KAN.—The Missouri & Kansas Telephone Company has announced that it has decided to raise the rentals on telephones $1 a month to business houses. Instead of charging $24 a year, $36 will be charged in the future. It is said that the price of $1 a month or $12 a year will remain in force for private residences. The agents for the company here say no profit can be made by renting business telephones for $2 a month. The low price has prevailed for six years, since the starting of the rival company.

MANHATTAN, KAN.—At a meeting of the telephone managers at Manhattan, Kansas, a short time ago, it was decided that work on the new Independent telephone toll line to Kansas City will begin as soon as possible. The company will be incorporated for $100,000, paid up capital stock. The new company expects to put up enough copper wire to handle the business out of Kansas City with ease. Ten wires will be put up between Kansas City and Topeka, six between Topeka and Junction City and four between Junction City and Salina. The promoters expect to enter Kansas City, Kansas, by January 1, but the time of entering Kansas City, Missouri, will depend upon how soon a franchise is granted for an Independent Company. The line will be a trunk line and will only break in on county seat towns.

MCPHERSON, KAN.—A new telephone line is being constructed from McPherson, Kansas, to Burton.

TOPEKA, KAN.—The Pankey telephone poles are being erected, and Topeka will soon have two telephone systems.

NEBRASKA.

PAPILLION, NEB.—F. H. Whiteker, a telephone electrician, formerly located in Topeka, is now engaged as superintendent of construction for the Home Telephone Company, of Papillion, Nebraska. The company is putting in three exchanges, connecting a number of towns with copper metallic circuits. "Farmer lines" are also being put in to give farmers connection with central on metallic party lines at the rate of $1.50 per month.

KENTUCKY.

HAZARD, KY.—A telephone line has been built from Hazard to Jackson, Kentucky, by citizens of Hazard, and the venture is proving a success.

HUMPHREY, KY.—A telephone line is being built from Mintonville to Humphrey, Kentucky, where it will make connection with the Middleburg lines.

LOUISVILLE, KY.—When the representatives of the corporations have nothing better to say against the wire ordinance than that it will require an expenditure of from $8,000,000 to $10,000,000, they discredit their own

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position. Ten million dollars would replace the entire plants of all the telegraph, telephone, electric light and street car companies in Louisville. These gentlemen must come forward with more reasonable arguments and statements or get out of the way.

MIDDLEBURG, KY.—A telephone line is being built from Mintonville, this county, to Humphrey, where it will make connection with the Middleburg lines.

LOUISIANA.

NEW ORLEANS, LA.—Thru the efforts of Congressman Broussard and Mr. R. F. Hogsett, the veteran telephone manager, a consolidation of all Independent telephone systems in Louisiana has been perfected and merged into the Telephone Company of America, with a strong financial backing. Mr. Hogsett has been appointed manager for this southwest Louisiana district, and some important changes will soon be made that will give the most complete and up-to-date service yet devised. Telephones will be installed in all places of business and residences, and a minimum charge made for every call. Maps of New Iberia, Lafayette, Crowley and other towns have been made and soon materials will be coming in to establish the new system. For years Mr. Hogsett has battled against the powerful Cumberland Company, holding his own at times against great odds; and he feels now that he has won his battle and given his big antagonist a competitor that it will have a wholesale reverence for. Congressman Broussard is spending much time in New Orleans to secure franchise rights for the new company, when they will establish an exchange in that city and also the long-distance service. The Telephone Company of America has its headquarters at Washington, D. C.

MAINE.

BRUNSWICK, ME.—A syndicate of Brunswick men are to establish a telephone line to Harpswell connecting at Brunswick with the line already established. The tariff rate for talking with Harpswell will be 15 cents.

GREENVILLE, ME.—Telephone posts have been erected and wires strung so that messages may be sent from Greenville to Lily bay. The line will soon be extended to Kineo by the way of Spencer bay.

NORRIDGEWOCK, ME.—The Norridgewock & Fairfield Telephone Company has been organized at Norridgewock for the purpose of erecting and maintaining a telephone line between Norridgewock and Fairfield, with $100,000 capital stock, of which $200 is paid in. The officers are: President, E. H. Toby, of Norridgewock; treasurer, J. D. Ames, of Norridgewock. Certificate approved October 12, 1901.

MASSACHUSETTS.

AVON, MASS.—A short time ago the Southeastern Massachusetts Telephone Company asked the authorities for a franchise for an underground system thru the town. The papers are drawn up and are awaiting the signature of the telephone company and the town officers. The system will run on East and West Main streets.

BOSTON, MASS.—The Fall River Automatic Telephone Company, organized under Massachusetts laws, with $135,000 capital stock, has started operations in Fall River with 506 subscribers.

GREENFIELD, MASS.—The petition for the dissolution of the Northfield Telephone Company was granted.

MARYLAND.

BALTIMORE, MD.—The Winchester Telephone Company, whose line extends thru Baltimore, Maryland, has been sold to a Pennsylvania syndicate composed of Messrs. S. L. Jones, H. N. Gett, G. D. Gett and T. J. O'Neill, of Hanover, Pennsylvania. The line extends over territory in Virginia, West Virginia and Maryland.

BALTIMORE, MD.—Chartered: Hughes Telephone Manufacturing Company, capital stock $100,000, for manufacturing telephones, by Charles C. Hughes, Edward L. Ward, William Hutcheson and others.

BALTIMORE, MD.—The resignation of F. W. Story as general manager of the Chesapeake & Potomac Telephone Company, and the appointment of U. N. Bethel, of New York, to fill the position, is taken as an indication that Baltimore will have a larger share in the direction of the business than heretofore, and that the headquarters of the company will be removed from Washington to Baltimore. It is understood that active steps must be taken to meet the new competition which has sprung up in and around this city.

CENTERVILLE, MD.—Diamond State Telephone Company will lay a cable across Chesapeake bay to establish telephone communication between Centerville and Baltimore.

CUMBERLAND, MD.—The Western Maryland Telephone Company, capital stock $100,000, has been incorporated. It will reach Frostburg, Lonaconing and other towns.

MICHIGAN.

ALLEGAN, MICH.—West Michigan Telephone Company has been incorporated, with a capital stock of $25,000.

BATTLE CREEK, MICH.—C. E. Tarte, manager of the Citizens' Telephone Company of Grand Rapids, and Edward Land, chief electrician of that company, are in this city looking over the plant of the Calhoun Telephone Company, for the purpose of extensively improving it.

DETROIT, MICH.—The Michigan Telephone Company has made a proposition to the school board to furnish telephones in the inspectors' houses if the board would relinquish the twenty-five free telephones put into the schools by the Detroit Telephone Company.

DETROIT, MICH.—Articles of incorporation have been filed by the American Telephone

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Directory Company of this city. Capital stock $5,000.

ECORSE, MICH.—Wright D. Smith, of Ecorse, secured a judgment of $200 from the Michigan Telephone Company for removing his telephone from his Ecorse residence. Mr. Smith had a direct line to Detroit and claimed that his contract price was $24 per year. The company finally removed the 'phone last June, Attorney Thompson stating that the reason was because the price was too small. Mr. Smith sued for $325 damages, and Justice Somers allowed him $200. The company will appeal the case to the Circuit Court.

ELMDALE, MICH.—The Citizens' Telephone Company has its lines nearly completed to this place from Saranac.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company, of Grand Rapids, Michigan, has taken control of the Independent telephone exchange in Battle Creek.

GRAND RAPIDS, MICH.—Grand Rapids claims to be the banner telephone city in the country. There are about 7,500 'phones in service there, which is at the rate of one to every twelve inhabitants. In Detroit the figure is one to twenty-eight and in Chicago one to sixty-one.

KALAMAZOO, MICH.—The southern division of the Michigan Telephone Company has been organized with headquarters here. C. E. Wild, of this city, is superintendent. The division comprises the counties of Allegan, Barry, Eaton, Ingham, Van Buren, Kalamazoo, Calhoun, Jackson, Berrien, Cass, St. Joseph, Branch and Hillsdale.

LANSING, MICH.—The Michigan Telephone Company has opened up a new direct line between Lansing and Albion. The line will connect this city with Diamondale, Eaton Rapids, Springport, Devereaux and Albion. Engineers in the employ of the Citizens' Company are now surveying for a new copper circuit between Lansing and Detroit and within in a short time the work of setting the poles will be commenced, starting from Howell and working in both directions. A large force of men will also begin at Detroit and will build the line to Plymouth. The total distance to be covered is eighty-eight miles.

NORTHVILLE, MICH.—At the annual meeting of the Northville Telephone Company the following directors were elected: President, Dr. J. M. Burgess; vice-president, Dr. R. M. Johnson; secretary, R. H. Porter; treasurer, E. H. Lapham; A. K. Carpenter, W. H. Yerkes, W. G. Yerkes, F. S. Neal. It was decided to increase rentals to $1 per month for residence, and $1.25 for business places.

ORION, MICH.—Orion Telephone Company has been incorporated, with a capital stock of $1,000.

YPSILANTA, MICH.—An Independent telephone company has applied for a franchise and the council is said to look with favor on the matter.

MINNESOTA.

ANOKA, MINN.—The Minneapolis Telephone Company is building a telephone line from the Twin Cities to Duluth. It goes thru Anoka county near Bethel station.

ASPELUND, MINN.—The Wanamingo and Holden Mutual Telephone Company met in the town hall and adopted its constitution and by-laws. Five directors were elected. The meeting was well attended and great interest shown by those present.

NORTH BRANCH, MINN.—The Minnesota Telephone Company, of North Branch, Minnesota, has filed an amendment to its articles of incorporation, increasing its capitalization to $50,000, and its limit of indebtedness to $20,000.

DULUTH, MINN.—The Duluth Telephone Company has completed its toll line to Lake Nebagamon, Wisconsin. The toll charge is 25 cents.

MANKATO, MINN.—The directors of the Mankato, (Minn.) Citizens' Telephone Company have been talking over plans for the future. The plant is growing all the time, and is approaching the limit of present accommodations. The directors are contemplating important changes next spring or summer that will greatly increase the facilities for business. The company has connected up with the farmers' line at Lura Lake, by way of Delavan. Negotations are on foot looking to connecting with the Sterling-Amboy Independent line. The line from Mapleton to Good Thunder is completed and the section from Good Thunder to Garden City will be put in as soon as possible. The company already has a line to Garden City, so that the entire southeastern part of the county will soon be connected up.

MINNEAPOLIS, MINN.—The Rapid Service Telephone & Telegraph Company, Minneapolis, Minnesota — to operate, construct and control telephone and telegraph lines in Minnesota. Capital stock, $100,000. Incorporators: Eder H. Moulton, Robert H. Newlon, John A. Modisette, Franklin Benner and Claude B. Leonard, all of Minneapolis.

MINNEAPOLIS, MINN.—W. C. Hodder, right-of-way agent for the Northwestern Telephone Exchange Company in Minneapolis, recently died suddenly of heart failure.

MOUND CITY, MINN.—The Dakota Central Telephone Company has purchased the Eureka Telephone Exchange and the line from Eureka to Mound City. By this move the newo towns on the Soo line will be connected with the Dakota Central system of lines. Manager Zeitlow announces that as soon as possible the line will be pushed on to Biswarck.

PORTLAND, MINN.—Messrs. George Watson and George Cass, who bought the Northwestern telephone line from Eitzen to Wilmington, have taken it down from Wilmington to Portland.

ROCHESTER, MINN.—The Rochester (Minn) Telephone Company is branching out into all parts of Olmstead county, and has fifty subscribers on its branch lines.

ST. PAUL, MINN.—The Twin City Telephone Company is making arrangements for

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the installation of its promised private telephone exchange in the city hall.

ST. PAUL, MINN.—The Independent anti-Bell 'phone line from Duluth and Superior to Minneapolis and St. Paul, Minnesota, will be ready for use next spring.

SENORA, MINN.—The Phoenix Telephone Company has sold its plant to the Winona Telephone Company.

WINONA, MINN.—The Winona Telephone Company has purchased from the Phoenix Telephone Company, of Rushford, its toll lines and exchanges at Rushford, Lanesboro and other places in Fillmore and Houston counties. The consideration named is $15,000. The purchase increases the toll lines of the Winona company to 700 miles, all of which will be available to Twin City. Independent companies when the toll line from there to here is completed this fall.

MISSOURI.

CORTICELLO, MO.—Citizens' Telephone Company of North Missouri, of Corticello; capital stock, $1,200. Incorporated by C. O. Raine, P. N. Hanna, C. M. Little and others.

FARMINGTON, MO.—The Farmington Telephone Company, of Farmington, filed a statement of increase of capital stock from $5,000 to $10,000.

JEFFERSON CITY, MO.—The Capital Telephone Company, of Jefferson City, Missouri, has purchased the telephone line formerly operated between Jefferson City and Hickory Hill. It will be made a part of the local system of Jefferson City.

KANSAS CITY, MO.—At a meeting of the telephone magnates held here it was decided that work on the new Independent telephone toll line to Kansas City will begin as soon as possible. The company will be incorporated for $100,000, paid up capital stock. The new company expects to put up enough copper wire to handle the business out of Kansas City with ease. Ten wires will be put up between Kansas City and Topeka, six between Topeka and Junction City and Salina. The promoters expect to enter Kansas City, Kansas, by January 1, but the time of entering Kansas City, Missouri, will depend upon how soon a franchise is granted for an Independent company. The line will be a trunk line and will only break in on county seat towns.

MACON, MO.—The Macon (Mo.) Telephone Company recently completed an Independent line from Macon to Ardmore. It is also running a new line to College Mound.

MOUNTAIN GROVE, MO.—The Wright County Telephone Company, of Mountain Grove, has been incorporated, with a capital stock of $2,500. The incorporators are J. H. Medley, J. F. McCourt, W. C. Dugan and others.

MAYSVILLE, MO.—The first annual meeting of the DeKalb County Mutual Telephone Company was held in this city and the meeting was largely attended. The reports of the old board of directors and officers were read and approved. The capital stock was raised from $5,000 to $25,000 and the board of directors were authorized to purchase any lines that they may deem expedient. The following were elected board of directors: E. A. Bunton, W. M. Fitch, N. Bird, J. B. Harper, H. Ziegenbein, W. T. Wingate, C. P. Faul, J. E. Roberts, S. F. Word.

NEWPORT, MO.—A telephone line has been completed from Bassett to Newport.

ST. LOUIS, MO.—The North American Telephone Company purposes to build a line frome Texas thru Indian Territory and Oklahoma to Kansas City and St. Louis.

STANBERRY, MO.—Stanberry is to have a new telephone exchange.

NEBRASKA.

AURORA, NEB.—An Independent telephone company was lately organized at Aurora, Nebraska, which will be known as the Hamilton County Farmers' Telephone Association. Exchanges will be put in at Aurora and Bromfield, and the entire county will be wired and 'phones placed in many of the farm houses.

BASSETT, NEB.—The Bassett-Springview Telephone Company completed a line between this place and Newport and placed telephones in E. L. Myers' lumber office, Levensky & Lipman's general store and Dr. E. F. Dood's drug store at Newport, all of whom have business houses in this town. The company now has a line in good working order which connects this town with Springview, Carns, Pine Camp, Spring Creek and Newport, and there are numerous telephones connected with the line at Bassett. The plant cost $2,200. It is giving satisfaction. The company has seventy-five stockholders. The line is forty-two miles long.

COOK, NEB.—The Home Telephone Company, of Cook, Nebraska, has been incorporated, with a capital stock of $30,000.

GLENVILLE, NEB.—Dr. Bailey is organizing a company to build a telephone line from Glenville to Inland.

SUTTON, NEB.—A telephone system for Sutton, Nebraska, has just been completed by the Nebraska Telephone Company.

NEW JERSEY.

ELIZABETH, N. J.—The Interstate Telephone Company, which has acquired by purchase many local telephone companies in Pennsylvania and New Jersey and bought the Elizabeth Mutual Telephone Company for $30,000 met here and organized. W. H. Rankin, president of the old company, resigned and Hugh Hammell of Trenton was elected president and Barker Gummere, Jr., also of Trenton, was elected treasurer. The following were elected directors: Hamilton F. Kean, Barker Gummere, Jr., Henry Loudenslager, William S. Hancock, P. H. Gilhooley, John W. Whalen and Lawrence O'Donnell. The company has decided to spend $100,000 in making over the system.

GAZETTE, N. J.—The plant of the Home Telephone Company in Gazette, N. J., will soon be sold under foreclosure of the mort-

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gage bonds which the Interstate Telephone Company holds.

TRENTON, N. J.—Barker Gummere, Jr., of Trenton, representing the Interstate Telephone Company, paid over to former City Treasurer John W. Whalen a check for $30,000 in trust for the purchase of the Elizabeth Mutual Telephone Company, organized five years ago. The new company will give connection to Camden, Paterson and Passaic and intermediate towns.

WOODSTOWN, N. J.—The Pilesgrove Township Committee has granted a franchise to the Interstate Telephone Company to erect poles and string wires on the highways of the township.

NEW YORK.

ALBANY, N. Y.—The Southern New York Toll Company of this city was incorporated with a capital stock of $100,000 to operate a telephone system in New York, Westchester, Putnam, Ulster, Orange and Rock and counties connecting Kingston, Newburgh, West Point, Haverstraw, Orangeburg, New York city, Yonkers, Peekskill, Croton Falls, Bedford, Portchester, Garrison, Cold Springs, Fishkill, Poughkeepsie, Tivoli, Port Jervis, and Weehawken, New Jersey. The directors are Howard Hendrickson, of Albany; Joseph Claudet, John H. Scofield, and George W. Sutton, of New Rochelle; David G. Whiting, of Grand View, and Samuel B. Rawson, Theodore M. Brush and Irving H. Griswold.

ALBANY, N. Y.—The Frontier Telephone Company, capital stock $500,000, has been incorporated to operate in New York State and west to Cleveland, with headquarters in Buffalo. James M. Thomas is the only New York director.

ARCADE, N. Y.—The Wyoming & Cattaraugus Telephone Company, of Arcade, New York. Capital stock, $10,000. Directors: Theodore Hayden, P. E. Merrill and B. B. Lewis, Sandusky.

BATAVIA, N. Y.—The Home Telephone Company, to which a franchise was granted about six months ago, in Batavia, New York, has begun work of laying conduits with a large force of men.

BUFFALO, N. Y.—The Independent Union Telephone Company, which has made its application for the franchise for the city of Buffalo has been in the business of installing telephone systems for the last eight years. It has systems in several town in Ohio, and has been organized under the laws of the State of New York, and is capitalized at $2,500,000. It has installed or is installing plants at Dunkirk, Fredonia, Batavia, the two Tonawandas, Lockport, Gasport, Medina, Albion and eight other towns around Albion, with an up-to-date telephone service. The company started not a year ago at Niagara Falls with 100 'phones and now has over 600, and the number is increasing daily. This is also true as to the Tonawandas and Lockport.

CANAJOHARIE, N. Y.—The Interstate Telephone Company is enlarging its lines in this village and making many improvements.

CORTLAND, N. Y.—At a meeting of the directors of the Cortland Home Telephone Company, Fred V. Bennett of Homer was appointed business manager of the company to succeed W. H. Jones, who recently resigned that position. Mr. Bennett has had charge of the toll station in Homer since the company was organized.

ELIZABETH, N. Y.—The Interstate Telephone Syndicate of Trenton and Philadelphia absorbed the Elizabeth Telephone Company and paid $30,000 for the plant. The negotiations were conducted by Barker Gummere, of Trenton, as agent for the syndicate, and John W. Whelan, one of the directors, for the telephone company. Mr. Gummere gave a certified check for the amount to Mr. Whelan, who will hold it in trust for the three hundred stockholders of the Elizabeth Company. Mr. Whelan then turned over to the Interstate Syndicate all the stock held by the Elizabeth Company. The Interstate Syndicate assumed control of the Elizabeth plant at once.

HORNELLSVILLE, N. Y.—The Century Telephone Company, with which the new Hornellsville Telephone Company is connected, now has connection with Canisteo and is putting in a number of 'phones and preparing to open an exchange there in a very short time. The new company is also pushing its work in Wellsville and will soon open an exchange there. The work of extending the lines eastward is progressing rapidly and Hornellsville will soon be connected with many towns on the new line.

JAMESTOWN, N. Y.—The Home Telephone Company, Jamestown, New York, is about to put in a 1,500 line telephone exchange, and is in the market for the entire equipment of instruments and lines; the lines will include several miles of underground construction.

MIDDLETOWN, N. Y.—The Wallkill Telephone & Construction Company has been incorporated; capital stock, $12,000. Directors: G. W. Ballou, of Wawayanda, and J. G. Harding and T. D. Mills, of Middletown.

NEWBURGH, N. Y.—The new telephone company of Poughkeepsie will run its wires across the Poughkeepsie bridge and have connection with Kingston, Newburgh and Hudson by January 1.

NEW YORK, N. Y.—New York Switchboard and Manufacturing Company, of New York. Capital stock, $4,000; directors, Ernest Ohnell, Peter Gran and A. P. Anderson, of New York city.

SOUTH OXFORD, N. Y.—The Cheshire Telephone Company is putting up its new telephone line to South Oxford. The following officers have been elected: President, P. H. Parker; secretary and treasurer, Alvin Williams; directors, Will Kilroy, T. A. Southworth, H. D. Spencer.

TROY, N. Y.—The Saratoga Telegraph & Telephone Company directors met in Balls-

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ton Spa this morning and let the contract to the Eastern Construction Company, of Philadelphia, for the construction of a line connecting Saratoga, Ballston, Mechanicsville, Waterford, Schuylerville and Greenwich.

TROY, N. Y.—Those interested in the Troy-Luverne telephone line, Troy, are making arrangements to begin the work.

UTICA, N. Y.—From Copenhagen to Boonville and Turenne and thence to Utica, New York, a telephone line is being constructed.

UTICA, N. Y.—The Otsego County Telephone Toll Line Company has been incorporated, with a capital stock of $10,000. The directors are John Geer, L. Barker and John A. Losee of Richfield Springs.

WATKINS, N. Y.—A force of men recently arrived in Watkins, New York, to commence the construction of the new telephone line which is to be built by the Watkins Telephone Company. It was originally the new Century Telephone Company, of Cleveland. It has secured over three hundred subscribers in that village and promises to give the best of service.

WAVERLY, N. Y.—The Waverly Telephone System of this place has just finished laying about 1,500 feet of underground conduits. New switchboards are being put in which will accommodate about 400 patrons, and other improvements are being made.

OHIO.

BELLEFONTAINE, OHIO.—The Bellefontaine Telephone Company has increased its capital stock from $50,000 to $75,000.

BOWLING GREEN, OHIO.—The Wood County Telephone Company has been organized with a capital stock of $200,000. The directors are Captain L. Black, James Hickox and F. A. Baldwin of this place, Mr. Morrison of Bryan, and Mr. Woodbury of Cleveland. The Bowling Green Telephone Company was absorbed by this company, which will at once extend its lines in this county.

BROOKVILLE, OHIO.—The Brookville Telephone Company, Brookville. Capital stock, $6,000. Incorporators: O. E. Baker, N. W. Rinehart, J. C. Snyder, Enos Shellabarger and W. Z. Miller.

CALDWELL, OHIO.—The Caldwell Independent Telephone Company is giving very fine service all over the State, having direct connection with over 1,200 towns and 60,000 telephone subscribers.

CINCINNATI, OHIO.—About twenty of the coöperative telephone companies in Southern Indiana have consolidated under the name of the People's Telephone Company. About 10,000 'phones are represented. Connections will be made with the new long-distance company of Indianapolis.

CINCINNATI, OHIO.—The Hamilton County Commissioners have voted to install a branch telephone exchange in the county buildings in Cincinnati. The cost of switchboard, six trunk lines and twenty-six telephones will be $1,060.

CLEVELAND, OHIO.—The Federal Telephone Company will issue bonds on properties now under construction in Detroit, Dayton, Mansfield, Canton, and several smaller towns.

DAYTON, OHIO.—The Home Telephone Company, of Dayton, has contracts made for 2,500 instruments. Real estate has been purchased in the business portion of the city and a telephone building will be erected, especially fitted for the work.

FAYETTE, OHIO.—Fayette Telephone Company is putting in a new switchboard doubling its present capacity — now some over a hundred.

GREENSPRING, OHIO. — The Greenspring Telephone Company has increased its capital stock from $8,000 to $15,000. Incorporators: E. L. Johnson and others.

MANSFIELD, OHIO.—The Mansfield Telephone Company increased its capital stock from $75,000 to $300,000. S. A. Ford is the president and M. D. Ward, the secretary of the company.

MANSFIELD, OHIO.—J. T. Belanger, manager of the Galion Telephone Company, has been transferred to Mansfield and will manage the new Independent plant now being constructed in that city.

His successor here will be M. Elza Taylor. Mr. Balanger has been he best manager the company ever had. During the time he has had charge of the exchange the list of subscribers has been doubled and many improvements made which insure better service.

NEWARK, OHIO.—John B. Lang has accepted the position of manager of the Newark Telephone Company at Newark, Ohio. Mr. Lang was formerly employed as an erecting expert by some of the larger telephone manufacturing companies of Chicago.

PORTSMOUTH, OHIO.—The Rev. J. E. Comer, of the United Brethren Church, will equip his church with telephones for the convenience of his congregation. A large fire alarm card will also be placed in the church and the location of all fires announced from the pulpit in order to prevent the rushing away of the congregation.

SANDUSKY, OHIO.— Besides the large expense incurred by placing new poles and new wires on the streets, the Home Telephone Company has added a new $1,200 switchboard to its plant, which has a capacity for 300 'phones besides the toll system. The company will have three day operators and two at night.

TOLEDO, OHIO.—The Empire Construction Company of Toledo has been incorporated. The company has seven different cities in prospect for new telephone plants. In each case a home telephone company will be organized and franchises secured, then plants will be installed by the Empire Construction Company. It will be a strong competitor of the Bell Telephone Company wherever it operates, as it has millions back of it.

WARREN, OHIO.—Incorporators of the Lane Construction Company, of this city, which was chartered at Columbus, with a capitalization of $5,000, are: W. T. Griswold, Thad

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S. Lane, W. A. Smith, Washington Hyde and A. I. Powers. The company will engage in the construction of telephone systems. Organization has not yet been consummated.

PENNSYLVANIA.

ALBION, PA.—The Albion Telephone Company has been granted a charter, the capital stock being $5,500. The company will have an exchange in Albion.

HARRISBURG, PA.—Cambria County Telephone Company, Cresson township, Cambria county; capital stock, $50,000.

HARRISBURG, PA.—The consolidation of the Pennsylvania Telephone Company, of Harrisburg, with the Central Pennsylvania Telephone Supply Company, which it purchased recently, has been effected and two new officers have been appointed. Mr. J. E. Wilkinson has been made auditor and Mr. John S. Furst toll agent. Mr. Furst was formerly secretary of the Central Company, with offices at Williamsport. They will have offices at Harrisburg. The dividend rate has been raised from five to six per cent.

KITTANNING, PA.—The farmers of Armstrong county have organized a telephone company with the following officers: T. G. Hosack, of Rural Valley, president; W. M. Espey, of Blanco, secretary; and P. A. Smeltzer, of Smeltzer, treasurer. The company is chartered and capitalized at $2,500, under the title of the Cowanshannock Independent Telephone Company. It is organized on a mutual basis, and already thirty miles of line are in operation.

MIDDLEBURGH, PA.—The Juniata & Susquehanna Telephone Company has a force of workmen building a line from Mahontongo, Juniata county, to Liverpool. When completed it will give a thru line from Millersburg, Dauphin county, to Selinsgrove, Snyder county.

NEWPORT, PA.—Wire thieves descended upon the line of the Delmarvia Telephone Company, leading to Newport, and stole 3,600 feet of copper wire. All the companies in this section have suffered severely from similar thefts.

NIPPENOSE VALLEY, PA.—It now looks as tho a telephone line would be built thru Nipneose Valley, Pennsylvania.

PITTSBURG, PA.—Arrangements have been made by the Pittsburg & Allegheny Telephone Company with the West Penn Telephone Company, by which the former will be able to reach and control all of the territory now operated by the West Penn Telephone Company. The West Penn Company operates in the towns of MacDonald, Candor, Midway, Burgettstown, Washington, Claysville, Taylorstown, Buffalo, West Middletown, Independence, Wellsburg (W. Va.), Bethany (W. Va.), Patterson Mills and Cross Creek. A connection is now being built from the Carnegie exchange to MacDonald.

RIDLEY PARK, PA.—Council has granted a franchise to the Keystone Telephone Company of Philadelphia.

SCRANTON, PA.—The Lackawanna Telephone Company has a unique scheme for securing efficient service at its Scranton exchange. By means of an automatic register each call that comes into the exchange and the time required by the operator in answering the same is recorded. At the end of the month the calls and the time are checked up, and prizes are awarded the operators in accordance with the record.

TENNESSEE.

CARTER COUNTY, TENN.—The Holston Telephone Company is extending its lines and otherwise improving the property owned by the company in Carter county, Tennessee.

MEMPHIS, TENN.—James S. Warren, general manager of the Memphis Telephone Company, and the representative of the Independent system, denies the rumor that this company is to be absorbed by the Cumberland company.

NASHVILLE, TENN.—The Tennessee Telephone & Telegraph Company, Nashville, Tennessee, is to build a telephone company in Nashville and extend it over the State; capital stock, $10,000. Incorporators: Sanford Duncan, George I. Waddey, Charles H. Brandon, C. R. Handly and John B. Keeble.

RUSSELVILLE, TENN.—The telephone exchange is now in operation in the city, altho all the 'phones are not in place as yet. This line connects with the long-distance at Tuscumbia.

TEXAS.

AUSTIN, TEX.—The new Independent Telephone Company is making extensive repairs on its general office and local exchange building on West Eighth street. The local telephone system will soon be completed and ready for operation.

BEAUMONT, TEX.—Beaumont Northwestern Telephone Company, of Beaumont; capital stock, $10,000. Purpose, to build and operate telephone lines in Jefferson and a number of other counties of East Texas. Incorporated by J. M. Smith, W. S. Bruce and John Notaro.

CALVERT, TEX.—The telephone line between Calvert and Maysfield has been completed and greatly facilitates trade between this place and territory tributary to Calvert on the west side of the Brazos river in Milam county.

CALDWELL, TEX.—The charter of the Trans-Texas Telephone Company, of Caldwell, Texas, with a capital stock of $10,000, was filed in the secretary of state's office. The incorporators are J. D. Giddings, J. S. Giddings and Robert S. Leonard.

FREDERICKSBURG, TEX.—Fredericksburg enjoys telephone connections with the outside world, same being furnished, long and short distance, by the Southwestern, Eureka and Martin Telephone companies. The lines are liberally patronized and the service is all that could be desired. Mrs. Julius Kordzik is in charge of the local exchange and is popular with its patrons.

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GALVESTON, TEX.—A telephone line is being constructed from Hitchcock to Galveston.

LONE OAK, TEX.—A charter of the Citizens' Telephone Company, of Lone Oak, Texas, with a capital stock of $41,000, was lately filed. The incorporators are W. W. Patillo, W. C. Bellah, W. G. Patterson and others.

MINERAL WELLS, TEX.— O. R. Riddle was granted a franchise to erect telephone poles and to stretch wires over the streets of Mineral Wells. Mr. Riddle represents a long-distance telephone company, and by granting him permission to erect poles and wires will give Mineral Wells about the best long-distance telephone service in the State. This makes the second long-distance telephone system here.

MAYSFIELD, TEX.—A new telephone system has been put in operation between Calvert and Maysfield, Texas. The line is private property, but will prove of great convenience to citizens in both places.

SILVERTON, TEX.—A telephone line has just been completed from here to Tulia, and there connects with a line to Amarillo.

WACO, TEX.—An Independent telephone company, with headquarters at Waco, Texas, has made application to the city of Marshall for the privilege of running its line there.

WEATHERFORD, TEX.— Franchise has been granted the O. R. Riddle Independent Telephone Company for construction of a system.

WHARTON, TEX.—The Pittsburg-Glen Flora telephone line has been completed to Wharton, Texas, making the fourth Independent line running into that town.

UTAH.

SALT LAKE CITY, UTAH.—Another block of underground conduits for the telephone system has been ordered, and work will commence on it as soon as the block on First South between Main and State streets is completed. The new work will be on First South between State and Second East streets.

SALT LAKE CITY, UTAH.—The right of way requested by the representatives of the Telluride Power Company for power and telephone wires thru the county was granted by the county board.

VIRGINIAS.

GRAFTON, W. VA.—The Independent telephone companies of Central West Virginia have combined, and will be known as the Central West Virginia Telephone Exchange, with H. C. Henderson, of Parkersburg, president: P. W. Lowe, of Mannington, first vice-president; J. I. Alexander, of Clarksburg, secretary and treasurer.

ELKINS, W. VA.—The Consolidated Telephone Company, of Elkins, West Virginia, has purchased the Woodford telephone lines, which are operated in Barbour, Tucker and Randolph counties. The company now has three thousand subscribers, the new purchase adding five hundred.

NORFOLK, VA.—At a recent meeting of representatives of the Hampton Telephone Company and the Southern States Telephone Company it was decided to lay a new telephone cable between Norfolk, Virginia, and Hampton.

PIEDMONT, W. VA.—The Piedmont Telephone Company, Piedmont, to construct and operate telephone lines; capital stock, $10,000. Incorporators: J. T. Lanklin, Luke, Maryland; J. S. Jamison, Westernport, Maryland; C. D. Webb, Timothy Kenny, of Piedmont; and E. Boynton, of Barnum, West Virginia.

RICHMOND, VA.— It is stated that the city of Richmond, Virginia, will have to expend about $30,000 in placing its wires in conduits. it seems that this point was overlooked when the city granted a franchise to the Bell Company, providing that the city wir sehould go in the city's conduits.

WASHINGTON.

HILLYARD, WASH.— Hillyard now has a telephone exchange.

PULLMAN, WASH.—The farmers near Pullman, Washington, are operating a telephone line nine miles in length, composed wholly of barbed-wire fences. It works perfectly, and is proving a great convenience to all concerned.

SEATTLE, WASH.— Because a Seattle telephone girl was pert and impertinent and refused to connect a subscriber to the fire department when he wanted to give notice of a fire, a loss of $60,000 was incurred, and now the telephone company is being sued for damages by the person refused service and by the insurance company which suffered the loss. Politeness is a merchantable article, even with a telephone girl.

WISCONSIN.

CHIPPEWA, WIS.—Articles of amendment to the instrument of incorporation of the Chippewa County Telephone Company, Limited, have been filed with Register of Deeds John H. Stanley. The amendment increases the capitalization of the company from $3,000 to $30,000, and is signed by Austen H. Hunt as president, and Grant Young as secretary.

EAU CLAIRE, WIS.—John Avery, who has been manager of telephone exchanges for the Wisconsin Telephone Company for several years, and was at one time a lineman here, this being his old home, has been made manager of the exchange at Eau Claire. Mr. Avery is a brother of the Misses Belle and Edna Avery of this city.

EAST TROY, WIS.—The Farmers' Telephone line is now in operation. There are 110 subscribers.

FRANKSVILLE, WIS.—The Wisconsin Telephone Company decided to extend its system as far west as Franksville. A sufficient number of farmers in Caledonia have subscribed to make the improvement advisable.

GREEN BAY, WIS.—The Green Bay & Lake Michigan Telephone Company, of which ex-

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Governor Scofield, of Oconto, and Edwin T. Munger, of Green Bay, are the chief promoters, have filed a petition with City Clerk Reichert, asking for a franchise to operate in this city. If the franchise is granted, the Wisconsin Telephone Company, of this city, will be forced into competition with the new organization, which offers a considerable reduction for its service. The franchise provides for the construction and operation of the lines within one year from the time of the granting.

LA CROSSE, WIS.—It was formally announced that the Twin Cities Telephone Company, of Minneapolis, would construct an Independent long-distance line of copper between the Twin Cities and La Crosse, the improvement to cost in the neighborhood of $250,000. Work has already been commenced, and it is thought the line will be completed by Thanksgiving.

MADISON, WIS.—Articles of incorporation have been filed at Madison, whereby Waterloo will have a new telephone exchange. It will be known as the Interurban Telephone Company.

MADISON, WIS.—The Interurban Telephone Company, of Madison, Wisconsin, has filed articles of association with the Secretary of State, its purpose being to construct, operate and maintain a system of telephone lines and exchanges in Wisconsin, and which may be extended outside the State. The capital stock is $200,000, and the incorporators are A. L. Hutchinson, H. E. Kepler and Charles Schernecker.

OSHKOSH, WIS.—Oshkosh has had experience with two systems of telephones covering the city, and also with the conditions after the Independent company had been absorbed by the Bell interests. A recent move to secure a franchise for another Independent system in Oshkosh has been made, and the local press indorses it and refers to the better service which existed during the days of competing exchanges.

PEPIN, WIS.—O. G. Potter, president of the Pepin Telephone Company, informs us that the line to Nelson has been completed and connection can now be had with Ttevino, Nelson, Alma, Wabasha, Fountain City and all points on the Hueffner lines in Buffalo county.

RACINE, WIS.—The annual stockholders' meeting of the Citizens' Telephone Company was held here, with one hundred present. Reports were heard showing that the company had 805 paying telephones in operation, altho the system is only five months old. It was shown that the earnings largely exceeded the expenses. Altho no dividend was declared, the officers are confident one will be paid before the end of the year. It is intended to extend the lines and increase the subscribers to 1,200, and efforts will be made to get toll service with larger cities soon. The old board of directors was reëlected.

WRIGHTSTOWN, WIS.—The Wisconsin Telephone Company will rebuild a portion of its line from Kaukauna to this village; the portion of the line to be rebuilt will be a metallic circuit. This is a much needed improvement.

OTHER STATES.

LAMAR, COLO.—The Lamar Electric Company has just installed one of the Eureka Electric Company's switchboards. Fred E. Cooper, who installed the new apparatus, says that the installation was made in record time. The company wired the Eureka company to ship the board by express, and the third day after that the board was in operation.

COVINGTON, GA.—An Independent telephone system was put in operation here during September. This is a competitor of the Bell Company, previously established.

MISSOULA, MONT.—The output of the telephone in this town has increased to such an extent that it makes Missoula the telephone center in the State for its size.

KEENE, N. H.—The New England Telephone Company is making arrangements to put in a new switchboard at the Keene, New Hampshire, exchange, and add a chief operator to supervise the service.

VERNON, OKLA.—A telephone line between Altus and Vernon has been completed.

WOODWARD, OKLA.—J. Alexander, of Clayton, New Mexico, representing the Plains Telephone Company, will put in a local telephone service in this city. The Woodward exchange will also be the central exchange for a number of long-distance lines, which have been needed here for some time.

UNITY, ORE.—The construction work has been started on the new telephone line between Whitney and Unity.

SHERIDAN, WYO.—Manager G. W. Griffen, of the Sheridan Telephone Company, recently stated that work on the extension of the telephone line to Banner would shortly be begun. This will give a telephone service to a large number of people and will add fifty or seventy-five instruments to the present system.

FOREIGN.

ALASKA.

DAWSON CITY, ALASKA.—J. B. Charleson, superintendent of construction of the Government thru telegraph line to Dawson, was banqueted by the citizens of Vancouver, G. R. Maxwell, M. P., presiding.

AUSTRALIA.

MELBOURNE, AUS.—The present state of the telephone in Australia is, we learn, being seriously considered in Melbourne with a view to placing the telephone system thruout the country on a uniform basis. Melbourne itself, with a switchboard thirty years old, is said to lag farthest behind, and the want for a standard system of telephony is being keenly felt. It is even stated that not a single telephone system in Australia is equipped with modern apparatus. A conference of the electrical experts attached to the postal departments of the several Australian States was

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recently held at Melbourne to consider how best the telephone system could be standardized. It was then arranged that the members should visit the more important towns in Australia in order that all of their members might be personally acquainted with the different systems in vogue, and presumably be more fitted to fix upon the best system for use thruout the Commonwealth.

BELGIUM.

BRUSSELS, BELGIUM.—The cable which will shortly put the English metropolis in direct communication with Brussels is to be landed at Paune and Ramsgate, on the Belgian and British coasts, respectively. Altho it was originally stated that telephonic communication between the two capitals would be established early in July this year, the work of laying the cable has only just been taken in hand. By the end of the present month, however, it is now promised that the cable will have been completely laid. The line from London to Brussels, which is to cost over £37,000, will be some 270 miles in length, of which about sixty miles will be submarine. Altho the new cable is ostensibly being laid with a view to putting London and Brussels in direct telephonic communication, it will also admit of conversations being carried on between the more important English and Belgian towns.

BRITISH COLUMBIA.

VICTORIA, B. C.—According to advices just received here from Japan, France is about to construct a telegraph from Tonquin to Amoy, and thence to Port Arthur, giving France direct communication to the far East, independent of British lines.

ENGLAND.

HULL, ENG.— Good progress is being made with the scheme for the erection of a municipal telephone service at Hull. It is stated that the municipality have already as many promises as there are subscribers to the National Company's system in Hull.

LIVERPOOL, ENG.—We will soon have direct telephone connection with Selinsgrove, Sunbury and other places north. The line is complete to Mahantango up, and the part between this place and Mahantango will be put up as soon as possible.

LIVERPOOL, ENG.— Experiments are being made by the Postoffice with a view of ascertaining how far it is possible to speak over the telephone. Conversation can now be carried on between Liverpool and Paris. Leeds subscribers, however, are not yet able to get thru to Paris, the submarine telephone cables not having proved altogether satisfactory. The most distant town to which Leeds telephone subscribers can speak is Dublin, the wire crossing the narrow strip of sea at Stranraer, and reaching the Irish capital via Belfast. The fee is 4s. 6d. for three minutes' conversation, or 3s. 6d. to Belfast. It is said that the words are nearly as audible as if spoken by a person telephoning from across the street.

LONDON, ENG.—The laying of the telephonic cable between La Panne on the Belgian coast and Ramsgate, which is destined to connect Brussels and London, has been commenced, and will be finished by the end of the month. The line from London to Brussels, which will cost about 900,000f., will be about four hundred kilometers in length, while about ninety kilometers will be submarine. The circuit will be constituted with a view of giving extensive communications to and from the principal English and Belgian cities.

TUNBRIDGE-WELLS, ENG.—The municipality of Swansea have lately been canvassing the town on the question of establishing a telephonic exchange in competition with that of the National Telephone Company. The original circular sent out by the town clerk on the subject would not appear to have had the desired effect, for another pamphlet is being circulated among the townspeople, pointing out that whereas a municipal telephone exchange would afford the same facilities as are now granted by the National Company, it would, furthermore, possess the following advantages: (1) subscribers would not be able to hear other subscribers' conversation; (2) the operator would not be able to listen to the conversation without the knowledge of the subscriber; (3) if a subscriber to whom you wish to speak is engaged, you would be called up from the exchange as soon as the number is disengaged; (4) the cost of a line for all these benefits, including mutual intercommunication with the National Telephone Company's subscribers, together with facilities for using the Postoffice trunk lines, would be £5 per annum, or, if preferred, subscribers would probably be able to get an instrument placed on their premises at about £2 per annum and 1d. per call, or £3 per annum and ½d. per call. In the face of these offers and the experience already gained at Tunbridge-Wells, where the Corporation, by their active competition, have forced the company to bring its tariff down to an exceedingly low figure, it will be surprising if the town of Swansea does not agree to go in for a municipal system. Putting the question of economy on one side, local telephone competition must result in a much more perfect system being obtained.

GREECE.

PATRAS, GREECE.— United States Concul Jackson, writing from Patras, Greece, under date of August 23, reports that there is under serious consideration the construction of a telephone line between Patras and Athens. While the project has so far taken no definite form, the business done between these two points will undoubtedly justify the undertaking. The amount of materials necessary for the equipment of such a line will be sufficiently large to merit the close consideration of American manufacturers.

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RIGHTS OF ABUTTING OWNERS AGAINST TELEPHONE AND TELEGRAPH COMPANIES.*

BY G. C. HAMILTON.

The introduction of the electric telephone and telegraph evoked many new questions of the law of real property. The general demand for a method of rapid intercommunication in the business and social world lead to the widespread dissemination of such lines, and, with general and increasing construction, the erection of poles and the replacing of wires, caused, in a measure at least, some detriment to the fee of the adjoining landholder. Upon many of the questions that have thus arisen the courts have held widely divergent views, but the general tendency of decision has been to afford companies constructing and operating telephone and telegraph lines as wide a latitude in their operations as is consistent with a proper interpretation of the laws governing real property. That telephone and telegraph lines may be, for all general purposes of the law, considered one and the same, there can be no longer any question. Stephen, J. says:[1] "I do not think it necessary to express any opinion on a controversy which is more scientific than legal, and perhaps more properly metaphysical or relative to the meaning of words than scientific, as it seems to turn upon the nature of identity in relation to sound. It is enough to say that whatever be the merits of the controversy, it does not appear to us that the fact, if it is a fact, that sound itself is transmitted by the telephone, establishes any material distinction between telephonic and telegraphic communication, as the transmission of it takes place and is performed by a wire acted on by electricity." And Brown, J., says:[2] "We see no reason to doubt the position assumed by the complainant that a telephone company is a telegraph company." This ruling seems to have been generally accepted and widely followed.[3]

Primary among the questions that have been raised by the abutting landowner is that concerning the subordination of the highway to the use of telephone and telegraph circuits. Is the erection and maintenance of such a line a use to which the highway may properly be subjected? or are the poles and wires a novel and improper use, foreign to the purpose for which the easement was acquired, and a new and additional burden upon the fee? Here the courts are at issue, and the opinions, each logical and of weight, widely divergent. Devens, J., says:[4] "The use of a portion of the highway for the public use of companies organized under the laws of the State for the transmission of intelligence by electricity, and subject to the supervision of the local municipal authorities, which has been permitted by the legislature, is a public use similar to that for which the highway was originally taken and to which it was originally devoted." The argument in this line of decisions would seem to be that the public streets are not limited in their use to the purpose of passways, or avenues for travel, but may be subjected to every use which promotes public convenience and comfort and is not inconsistent with the use to which they were originally dedicated.[5] It is further argued in those cases where this view has been taken, that the occupation of the streets by poles and wires takes nothing which the law reserved to the

*From the *Central Law Journal.*

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original proprietor of the land, when the public easement therein was acquired, nor does it appropriate it to a use not within the public easement.[6] That where land has once been duly appropriated to a public use, which requires the occupation of its whole surface, and is applied by legislative authority to another and similar use, no new claims for compensation unless expressly provided for can be sustained by the holder of the fee;[7] and so the erection of telephone poles and wires upon the public highway, in States where these views are held, does not impose upon the land a novel and additional servitude entitling the holder of the fee to additional compensation therefor.[8]

The contrary view is ably expressed in the opinion of Allen, J., in what may be termed one of the leading cases upon this subject, Pierce vs. Drew.[9] Here the learned judge, dissenting from the view of the majority of the court, says: "If it is incident to the laying out of a highway that a telegraph line may thereafter be established upon it, by the sanction of a future board of municipal officers, this right must of necessity be paid for at the outset, unless the owner of the land will have a subsequent claim for additional damages; otherwise his property is taken from him without compensation. It is going quite too far to hold that in law it must be deemed to have been within the contemplation of the parties at the time of the laying out of the highway that it might be used for such new and additional purposes. They are in their nature essentially distinct from the ordinary use of the highway by travelers. It is not desirable to impose this new and additional burden upon the laying out of the highways. If the public convenience and necessity require a new highway, but do not require a line of telegraph over it, the public authorities ought to be able to take such an easement as will subserve the public requirement without being subjected to the necessity of paying for a right which is not needed nor desired. The use of a highway for telegraphic purposes is not naturally included in the original design, not naturally incidental to its use for travel. Highways can be and are conveniently used without telegraph or telephones. The latter can be established without the use of the highway. It may be convenient in many instances to use the highway for electrical lines. Whenever this proves to be the case, there is no hardship in requiring those who wish to establish such lines to pay for the privilege such damages, if any, as may be caused to the owners of the property by such use."

Where this view is taken, the argument would seem to be that the power of the legislature over the streets is confined strictly to the use for which they were taken; that as trustee no greater title is taken than is necessary to the proper execution of the trust, and that, as the construction and maintenance of telephone and telegraph lines upon the highway do not come within the terms of a trust confined strictly to the protection of the public easement in the streets, a legislative franchise to companies, organized for the transmission of intelligence by electricity, permitting such construction is void and inoperative as against abutting owners.[10] It is held that the erection of poles and wires under legislative sanction, without the consent of the adjacent owner, who retains the fee in the highway, comes within the constitutional inhibition, "private property shall not be taken or damaged without just compensation."[11] Condemnation of land for the public use as a highway gives, it is argued, only the right of passage over it. The absolute property therein remains in the holder of the fee, and this is restricted and interfered with by the erection of poles and wires in or upon the land. The State does not possess this right, as trustee for the easement; it cannot constitutionally grant it to another.[12] A franchise to erect a telephone or telegraph line upon the public highway, in such a manner as not to incommode the public in its use, may be granted, but such lines form no part of the equipment of a public street, but are foreign to its use, and where the abutting owner holds the fee to the middle of the street he is entitled to extra compensation for the additional burden

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placed upon his land.[13] In short, a telegraph or telephone company is regarded as a public use only in the sense that the public by payment therefor, may become possessed of certain rights which the law will enforce. The true question at issue is whether or not the erection of poles and wires upon the highway constitutes an additional servitude upon the fee and so entitle the landowner to extra compensation therefor. There can, properly speaking, be no distinction between cases where the fee to the middle of the street is in the abutting owner, and those where it is in the public.[14] It is impossible to lay down any exact rule as to the circumstances that will justify the exercise of the power of eminent domain as against abutting landowners, or the holder of the fee in general.[15] For the purposes of this article we can merely examine the general principles. The use must be public, but it is not necessary that the public of an entire community be benefited by the use; a local use is undoubtedly sufficiently public.[16] So the condemnation of a right of way for a telephone company, whose operations were to be purely local, would be a proper exercise of the power of eminent domain, since public use and public benefit or utility are, in this connection, synonymous.[17] It is essential, however, that the user, or right of user, be in the public, and that this be the improvement for which the private property is taken, consequently it is necessary that the service of telephone or telegraph companies, seeking to acquire right of way for the erection of poles and wires, be available to the public of the locality in which the right of eminent domain is sought to be exercised, or at least available to the public in general.[18] The fact that the property of the individual so taken is bestowed upon a private person or corporation, and that private emolument and gain result from the use, will not prevent the exercise of the power in the case of telephone and telegraph companies as against abutting owners, since the use is public and public benefit the object in view.[19] There can, consequently, be no doubt that a telephone or telegraph line for the general transmission of messages is a use, on behalf of which the power of eminent domain may be properly exercised.[20] It has been held, in a recent Texas decision,[21] that a telephone company, organized under a statute providing for "a telegraph and telephone line" which formerly read "a telegraph or telephone" line is entitled to exercise the power of eminent domain under a statute giving such power to corporations created for the purpose of constructing and maintaining "a magnetic telegraph line."

As to the right of the adjacent owner to compensation for the obstruction of light, air, etc., by telephone and telegraph companies, there can be no question. The abutting owner has redress as against any substantial obstruction of his right of access, or his enjoyment of the use of the street in connection with his land.[22] The right to maintain shade or ornamental trees in front of property is clearly incidental to the ownership of the adjacent fee. In Ohio, where it is held that no additional servitude is imposed upon the land constituting highways by the erection and maintenance of the poles and wires of telephone and telegraph companies, such a company was held to have no right to trim trees, whether such cutting was necessary or not.[23] In Connecticut, where the statute permitting the construction of telephone lines says that trees shall not be injured without the consent of the owner, it has been held selectment cannot give authority to cut trees, even though such cutting be necessary, without the consent of the adjacent landowner.[24] In Mississippi, a telegraph company constructing under a permit from a county board of supervisors, acting under power conveyed by statute, was held to have acquired no power to remove trees or branches.[25] Where the abutting owner holds the fee to the middle of the street, and the courts view the erection of telephone and telegraph poles and wires as a new servitude upon the fee, it would seem that the trimming of trees and hedges entitles the abutting owner to compensation, if done without an express license from him.[25] On the other hand, even though the adjoining owner so holds the fee, if the poles and wires be considered no new burden

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upon the highway, and a use not foreign to the public easement therein, then a municipality granting a franchise to a telephone company, when acting under its powers to provide for public uses, grants therewith the power to do the necessary trimming of trees and hedges adjacent to such line,[27] a similar view being taken by the federal court.[28] Where the cutting is unnecessary or malicious, or where the trees are wantonly injured, as by the careless use of linemen's "climbers," the company is liable, certainly, for the damage actually sustained, and, in certain cases, even punitive damages may be obtained.[29] This would seem to be the rule, even though the cutting by the company's agents be in direct violation of its expressed orders.[30] As to the restrictions placed upon the adjoining owner, in his use of the fee, by reason of the proximity of telephone or telegraph circuits upon the adjacent highways, there are none save those to which he is subjected generally. The maximum of the law, "*Sic utere tuo ut alienas non laedere,*" applies equally well in the cases of companies for the transmission of intelligence by electricity against abutting owners. The freeholder can maintain upon his land anything to which he may, at common law, subject the fee, and he is liable only when he does not make "use of the means which the progress of science and improvement have shown to be the best" to prevent injury to another.[31] Kekewich, J., says:[32] "I cannot see my way to hold that a man who has . . . called into special existence an electric current for his own purposes, and who discharged it into the earth beyond his control, is not as responsible for damages as he would have been if he discharged a stream of water. . . . I hold that if it finds its way onto his neighbor's land and then damages the neighbor, the latter has a cause of action."

The court, in the case of the Hudson River Telephone Company vs. Watervliet Turnpike and Railroad Company,[33] says: "We are not prepared to hold that a person, even in the prosecution of a lawful trade or business upon his own land, can gather there by artificial means a natural element, like electricity, and discharge it in such volume, that owing to the conductive properties of the earth, it will be conveyed upon the grounds of his neighbor with such force and to such an extent as to break up his business or impair the value of his property, and not be held responsible for the resulting injury. . . . It cannot be questioned that one has a right to accumulate water on his own real property and use it for a motive power, but he cannot discharge it there in such quantities that, by the action of physical forces, it will inundate his neighbor's land and destroy his property, and shield himself from liability on the plea that it was not his act, but an inexorable law of nature that caused the damage. . . . If he collects for pleasure or profit the subtle and imperceptible electric fluid, there would seem to be no hardship in imposing upon him the same duty which is exacted of the owner of the accumulated water power—that of providing an artificial conduit for the artificial product if necessary to prevent injury to others."

So the erection and maintenance of plants generating or using electricity and employing a grounded return circuit to the detriment of telephone or telegraph lines upon the adjacent highway render the owners of such plants liable for all damages that may ensue from such interference, provided that, at a reasonable expense, by the adoption of proper and known appliances, the injury could have been avoided. There is no obligation to utilize devices that are in the nature of experimentation, but if proper means be generally known by which the escapement and consequent conduction may be prevented, the person generating or employing electricity fails to use them at his peril. There can properly be no distinction between the telephone company which, as a rule, from the nature of its business is compelled to make provision for its return circuit, and the person using an electrical current for purposes that do not require such provision.[34]

1 Atty-Gen. vs. Edison Tel. Co. 6 Q. B. D'v. 244
2 Cumb. Tel. & Tel. Co. vs. United Elect. R'y, 42 Fed. Rep. 273.
3 Duke vs. Telephone Co., 53 N. J. Law, 241; Wisconsin Tel. Co., vs Oshkosh, 62 Wis. 32; Chesapeake & Potomac Tel. Co. vs B. & O. Tel Co., 66 Ind. 410.

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4 Pierce vs. Drew, 136 Mass. 75.

5 Halsey vs. R. T. St. R'y Co., 20 Alt. Rep. 859; Guy vs. Mutual Union Tel Co., 14 Mo. App. 485; Julia Bldg. Assn. vs. Bell Tel. Co., 13 Mo. App. 477; Hewett vs. W. U. Tel. Co., (D. C.) 54 Am. Rep. 284; R. R. Co. vs. Newark, 10 N. J. Eq. 352.

6 Magee vs. Overshimer, 150 Ind. 127; Taggert vs. R'y Co., 19 Alt. Rep. 826; Williams vs. R'y Co., 41 Fed. Rep. 556.

7 Atty-Gen. vs. Met. R. R., 125 Mass. 515; Boston vs. Richardson, 13 Allen, 144.

8 Carter vs. N. W. Tel. Ex. Co. (Minn.), 40 Cent. L. J. 475; Young vs. Yarmouth, 9 Gray, 386; Chase vs. Sutton Mfg. Co., 4 Cush. 167; Hewett vs. Tel. Co., 4 Mackay, 424.

9 136 Mass. 75.

10 Met. Tel. & Tel. Co. vs. Colwell Lead Co., 67 How. Pr. 365.

11 Board of Trade Tel. Co. vs. Barnett, 107 Ill. 507.

12 W. U. Tel. Co. vs. Williams, 86 Va. 696.

13 Hudson River Tel. Co vs. Watervliet T. & R. R. Co., 135 N. Y. 393; Cin. & I. P. R. R. Co. vs. City & Sub. Tel. Assn., 48 Ohio St. 390; Dailey vs. State (Ohio), 37 N. E. Rep. 710; State vs. Newark, 37 N. J. L. 415; Weller vs. McCormick, 47 N. J. L. 397; Broome vs. Tel. Co., 42 N. J. Eq. 141; Dusenberg vs. Tel. Co., 11 Abb. N. C. 440; Stowers vs. Postal Tel. Cable Co., 33 Cent. L. J. 258; A. & P. Tel. Co. vs. C., R. I. & P. R. R. Co., 6 Bliss, 158.

14 Randolph on Em. Dom. Pars. 415, 416; McQuaid vs. P. & V. R'y Co., 18 Oreg. 237.

15 Olmstead vs. Camp, 33 Conn. 531.

16 Pom. note Sedgwick, Const. of State and Const. law (2 Ed.), 446; Township Board vs. Hackman, 48 Mo 243; Williams vs. School Dist., 33 Vt. 271; Hartwell vs. Armstrong, 19 Barb. 166; Coster vs. Tidewater Co., 18 N. J. Eq. 54; Talbot vs Hudson, 16 Gray, 417.

17 Salt Co. vs. Brown, 7 W. Va. 191; Todd vs. Austin, 34 Conn. 78; Dayton Mining Co. vs. Seawell, 11 Nev. 191; Bradley vs. N. J., etc., R. R. Co., 21 Ind 294; Great Falls Mfg. Co. vs. Fernald, 47 N. H. 456; Hand Gold Mining Co. vs. Parker, 59 Ga. 418.

18 Petition of Mt. Washington Road Co. 35 N. H. 134; Jordan vs. Woodward. 40 Me. 317; O'Reilly vs. Kankakee Valley Co., 32 Ind. 169. Lance's Appeal, 55 Pa. St. 16.

19 Anderson vs. Tuberville, 6 Cord. 150; Swain vs. Williams, 2 Mich. 427; Harris vs. Thompson. 9 Barb. 350; Matter of Townsend, 39 N. Y. 171; Concord R. R. vs. Greely, 17 N. H. 47.

20 New Orleans R. R. Co. vs. Southern Tel. Co., 88 Ala. 211

21 San Antonio & H. P. R. R. Co. vs. S. W. Tel. & Tel Co., 49 L. R. A. 459.

22 Zehren vs. Milw. Elect. R'y & Light Co. (Wis.), 74 N. W. Rep. 538; Jaynes vs Omaha St. R'y Co., 53 Neb. 631.

23 Daily vs. Ohio, 51 Ohio St. 348

24 Bradley vs. South New Eng. Telep. Co., 66 Conn. 599.

25 Clay vs. Postal Teleg. & Cable Co., 70 Miss. 406

26 Board of Trade Teleg. Co. vs. Barnett, 107 Ill. 507.

27 Southern Bell Telep. Co. vs. Francis & Allen, 109 Ala. 224

28 Southern Bell Telep. Co. vs. Constantine (Ala.), 6 Fed. Rep. 61.

29 Tissot vs. Southern Tel. & Tel. Co., 39 La. Ann. 993.

30 Graham vs. Chester Elect. Co., 39 N. Y. Supp. 125; Hoyt vs. Southern New Eng. Telep. Co., 60 Conn. 385; Boston vs. Cumb. Tel. & Tel. Co., 94 Tenn. 696; Postal Teleg. & Cable Co. vs. Lenoir, 107 Ala. 640; Postal Teleg. & Cable Co. vs. Brantley, 107 Ala. 683.

31. Cumb. Tel. & Tel. Co. vs. United Elect. R'y Co., 42 Fed Rep 279..

32 National Tel. Co. vs. Baker, 2 Chancery (1893), 201.

33 135 N. Y. 393.

34 Cumb. Tel. & Tel. Co. vs. United Elect. Co., 98 Tenn. 492.

TELEPHONES ON TRAINS.

A special train used by President Cassatt of the Pennsylvania Railroad for the inspection of the lines west of Pittsburg is equipped with a telephone service so arranged that communication can be had with each car on the train without the necessity of traveling from one car to another.

THE TELEPHONE IN RAILROAD SERVICE.*

BY F. P. VALENTINE.

(Continued from page 318.)

A long distance line in operation by one of the leading railroad companies of the country, connecting branch exchanges in four cities on its main line, thus breaking the line into three sections, is handling some 250 calls per day very comfortably. It is not thought that the maximum capacity of the line has yet been reached. The operators have been carefully trained in the handling of the calls for the various officials, preference being given to those highest in authority. By discriminating between the various calls asked for, and by intelligent operation, practically instant service is afforded the executive officers, while other calls of importance are handled next, leaving less important business to fill in the time on the wire. To accomplish such results, a system of tickets carefully checked is necessary. These tickets should show time call was received, forwarded, connected and disconnected, with a code record of all attempts made to complete connection, reasons for delays, etc. The facts thus shown are often of value in case of dispute, and from these tickets, a chart can be readily made, showing just what the line is doing at any minute during the day. From such a chart defects in operation can be immediately detected and corrected. With the development of this class of service many problems arise which require careful study, as many of the conditions attaching to public service do not apply to the railroad service.

The development of the long distance feature in railroad telephony has brought out the importance of proper construction of lines. Roads not equipped to construct proper telephone circuits will find it more economical to lease them from the telephone companies, but as their needs increase, they will undoubtedly find it to their advantage to organize a force of experienced telephone men to install and care for these circuits. Against the cost of these lines should be con-

*Read before the Convention of the Association of Railroad Telegraph Superintendents, at Buffalo, N. Y.

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sidered the fact that there is a great saving in time effected by this means of communication. In the instance cited of the line handling 250 calls per day, it is estimated that some 10,000 letters and telegrams per month are saved. This cannot but have its effect on all branches of the railroad service.

It is possible with experienced men to build and maintain properly constructed telephone circuits on the right of way of the railroad company, if necessary, running them upon the telegraph poles, but careful attention must be paid to details, or the results wil not be satisfactory. Induction from high tension currents will give more or less trouble, but this can usually be overcome by careful transposition of the circuits. At terminals it will be found most economical in the long run to do away with overhead construction and provide a liberal equipment of underground cable, figuring a large surplus capacity for future growth. The maintenance cost of such a plant is small, and in a few years it will pay for itself in the saving in the cost of maintenance over the open wires. It will be found advantageous also, where there is heavy suburban railroad traffic, to extend the cable beyond the terminal limits. In the case of one road doing a heavy four-track suburban business, covering a distance of ten miles from the terminal station, it has been found economical to run a lead covered paper cable on the telegraph poles the entire distance, utilizing the conductors for both telephone service and the various signal circuits between the block towers. In this case it was impossible to find room on the existing pole lines for the necessary number of open wires. It was found possible to install this cable quite economically, as it was run from a work train running at a low rate of speed, the suspension wire having been put up first, and over 1,000 feet per hour run, and that when obliged to give way to one scheduled train each hour.

It is also possible by using cable to elaborate the telephone service by utilizing the dead ends of the circuits terminating at various points, thus affording additional direct connections between towers and points having much intercommunication, simply adding small switches to the telephones and thus relieving the main switchboard of much operation.

The equipment best suited to the needs of the various departments is worthy of some attention. Originally, a desk stand set was considered somewhat of a luxury, but in the case of an official having to answer from thirty to forty calls per day, much time is saved by the telephone being right at hand, instead of his being obliged to leave his desk for the call. Some rather interesting figures have been taken, giving the comparative results of the use of the desk stand as compared with the ordinary wall equipment. In the case of two railroad exchanges connected by a long distance line, one being equipped mostly with wall, and the other with desk stand sets, it was found that it took on an average of fifty seconds longer to get the party ready to talk with wall sets than with the desk stands, which on the number of long distance calls per day, amounted to a loss of one out of six busy hours, in the use of the circuit. The rental of the line amounted to several dollars per day, while the cost of proper equipment was but a few cents per day.

In developing a railroad telephone system, uniformity in equipment is essential, as, sooner or later, a large proportion of the telephones will be brought into the general branch exchange system. Private lines are built at different points, and, as the circuits from the principal centers are extended, it will be found of advantage to arrange switching connection with these private lines. If uniform equipment is adopted, changes in the instruments will not then be necessary.

To obtain the best results with a system having several hundred miles of wire and several hundred instruments to care for, there should be a properly organized force to make regular and systematic inspection and repairs, and care for instrument and line troubles on short notice. This force should be preferably composed of experienced telephone men, as the average telegraph or signal linemen lack the necessary training to produce the best results.

The extension of the branch exchange

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system is not confined to points on the railroad premises, but direct connections are made from switchboards to the residences of the officials and to the switchboards of other roads, until the larger railroad telephone systems have become an important part of the commercial system of the territory in which they operate. If the residences of the operating officials of the railroad are equipped with telephones and connected either with the public service or direct to the branch exchange, it is possible to immediately notify them out of business hours of any emergency or of accidents, so that they can quickly be on the ground or direct matters from their homes.

A great deal of dissatisfaction with telephone service, resulting in the claims of liability to error in the transmission of messages by telephone, is occasioned by the fact that only about 10 per cent of the users of telephones know how to talk properly. Telephone users should be taught how to use the instrument and also to express themselves clearly and concisely, as much time is wasted in needless repetition.

It has been found of advantage to utilize stenographers in connection with switchboard operation, that messages may be taken in the absence of the party desired and on his return can be delivered to him. The use of stenographers and typewriters in connection with railroad telephone service will undoubtedly be developed with the extension of the service, as it is possible for an expert typewriter to take direct from the telephone at a greater speed than from the telegraph.

As the lines are extended, reaching the various junction points and stations, with trunk lines between the boards, and to the various centers, constantly increasing use will make it imperative to furnish only the best class of equipment to give satisfactory service. When the lines have been properly built and equipped, and there is due appreciation of the value of the service to the railroad, the matter of expense in comparision with the results will not be considered in the same light as heretofore.

When railroads have equipped themselves so that they can care for their commercial and domestic office business, the question of train operation by telephone, instead of telegraph, will be settled on its merits, but this should not be attempted until the equipment is sufficient and suitable, and the service is brought up to a standard that will compare favorably with that furnished by the more progressive of the telephone companies. Much of the criticism as to the danger of transmitting train orders by telephone has been justly based on the poorly constructed lines and cheap equipment used by many of the railroads, under the belief that economy in initial cost is the principal thing to be considered.

In itself, the substitution of telephone for telegraph is no more radical a change than took place when reading by sound supplanted the use of the register on the telegraph wires.

It can be predicted that the next few years will see some developments in the application of telephony to railroad service that will surprise some of those whose conservatism has led to the long delay in the appreciation of what seems destined to become the chief means of communication in the future.

SILK FROM SPRUCE.

Silk of excellent quality is being made from the spruce tree in Europe, and a movement is on foot to establish the industry in this country. It is said that the cost of making silk by this process is one-fifth that of the spinning from the silk-worm cocoon. The fiber takes dye as readily as the animal product and can be woven as securely and rapidly. It is also claimed that the tensile strength of the fabric is as great, if not greater, than the real silk.

Although the spruce lends itself to the process better than most woods, other forms of pulp can be used, the inventor even declaring that old newspapers, after they have been cleaned of the printers' ink, may be readily made into silk. The inventor, who has made the subject a study for twenty years, based his experimental work on the fact that the silkworm in eating and assimilating the leaf

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of the mulberry tree, obtained the foundation of the silk from vegetable fiber. In trying to hit upon the particular chemical process that the original fiber went through before it was spun as silk by the loom, he found that after the fiber had been separated it needed the chemical action of a certain form of glucose. In the new treatment the tree is crushed, and the resulting fiber is mixed with glucose and then placed in deep metal tubs. A disk, somewhat like a steam piston, is then forced down on the mass by hydraulic pressure until it is compressed into a very heavy gum. At the bottom of the tubs are tubes terminating in tiny glass nipples, with exceedingly small apertures. Under the hydraulic pressure the mixture is forced out of these glass nipples in silk-like fibers, which are so fine that the girls who are employed in this portion of the process are obliged to wear highly magnifying glasses in order to see when they break. The material is then carried over electrically heated drums, which dry the ether and the alcohol out of it. It is then plunged into iced water, dried and spooled for the looms.

THE TELEPHONE HABIT.

"The telephone habit has become a disease with a great many persons," said a New Orleans specialist yesterday, "for it is a curious fact that there are many persons who are almost constantly rushing to a telephone for one purpose or another. I have a friend who is fearfully afflicted that way, especially when he is under the influence of liquor. If he gets a few drinks ahead of the normal supply he immediately begins to telephone. He begins to call up his friends, and he will talk and talk until one would think that his tongue and ear would tire. But he keeps it up, and there are many other men who do exactly the same thing under the same circumstances.

"The telephone habit, however, is not confined to men who occasionally get under the influence of liquor. Sober men frequently do the same thing. The women are by no means exempt. Take many of the younger women, and they will find that they are passionately fond of calling their friends up over the telephone and chatting with them about the little nothings of their girlish life. Now, there is a serious side to this business of using the telephone to an excess. The telephone is a great thing. Electricity is a healthy article. But it cannot be successfully contended that talking over the telephone is the perfectly natural way of talking. There may be some harm in it.

The ear is pressed too close against the head, and the voice is greatly strained beyond its natural pitch. On the other hand, however distinct the voice may be at the other end of the line, there is a perfectly natural, but probably unconscious dread on the part of the listener that all that is said will not be heard, and so the hearing is strained So it might happen that in course of time the physical appearance of the human ear would be changed if the practice is indulged beyond the point of reason. The ear might be flattened out until it would be as smooth as if it had been pressed with a flatiron. It might work out the little creases and curves which add so much to the beauty of its appearance. The human voice, too, may lose something of its mellowness, and the hearing may be considerably deadened. Of course, these are mere contingencies. But this is an age of dreaming, and I guess I have as much right to dream as any other man. It would take probably several centuries to work the changes indicated, but the excessive use of the telephone will probably do the work.

"Just think of the awfulness of the thing? Here is the telephone flattening out the human ear, and on one side of the head at that, robbing the human voice of its mellowness, and deadening the hearing, and here is the bicycle humping the human back and spraddling the human legs. Really, it is not a pretty thing to look upon."

TO DRILL HARD STEEL.

Use turpentine instead of oil when drilling hard steel. It will then drill readily, when oil would be of no effect.—Shop Talk.

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TELEPHONY.

BY DR. V. WIETLISBACH.

Reported investigations of the value of the amplitude of the diaphragm are quite as various. According to the experiments of Frolich, it amounts in talking to 0.035 mm. (0.0014 inch) when computed from the size of the mirror diagram. The Engineers' Bureau of the German Postal Service found the amplitude for a very loud tone to be 52.10^{-6} mm., that is, one thousand times less than Frolich's result, and Poscha records the amplitude of the most faintly audible tone to be 2.10^{-6} mm. The amplitude for speaking must certainly be considerably greater than that of a mere hum, and it is fair to estimate it at .01 to .001 millimeter (0.0004 to 0.00004 inch).

6.—THEORY OF THE TELEPHONE.

With the above considerations and experimental results as a basis, tthe following theory of the working of the telephone may be advanced.

On the assumption that the magnetic field is produced by a strong permanent magnet, and that the variations due to undulating currents form only a small fractional part of it (it may be less than one-tenth), then the mechanical force exerted by the magnetic field to move the diaphragm is proportional to the intensity of the undulating current, as shown by the observation of Heaviside and the experiments of Frolich. If, for example, an electric current wave $I=A \cos mt.$, be flowing in the telephone coil, then the actuating force operating upon the diaphragm is $K = P A \cos. mt.$

The constant P—which is determined by the construction of the telephone, the number of convolutions, the strength of the magnetic field and the dimensions and quality of the iron parts—is called the electro-magnetic potential. Under the influence of this external force K, the diaphragm is compelled to perform its vibrations. The theory of the vibrating diaphragm is not yet sufficiently developed to make an exhaustive examination of the telephone diaphragm profitable. We shall, therefore, content ourselves with an approximation, premising that the lateral tensions in the diaphragm completely compensate one another, and that its separate points move normally as regards the surface, statements which are the more exact as the amplitudes of the vibrations of the diaphragm are smaller.

In ordinary telephony this condition is always fulfilled, and the diaphragm may be said to move freely.

If u represent the coördinate which marks the displacement of any point in the diaphragm from its position of equilibrium at any given moment t, we shall have the following differential equation to determine the motion of the diaphragm under the influence of the external force K.

$$M\frac{d^2u}{dt^2}+R\frac{du}{dt}+Eu=PA\cos mt.$$

Here

M represents the mass of the diaphragm.

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R the resistance of the atmosphere and the rigidity of the diaphragm.

E its elasticity.

The complete solution of the differential equation is as follows:

$$u=\frac{P.A.\sin z}{M.R}.\cos(mt-z)+Ce^{-\frac{1}{2}.Rt/M}.\cos\left(\frac{\sqrt{E^2-\frac{1}{4}R^2}}{M}.t-a\right)$$

in which C and a are constants depending upon the original condition of the diaphragm, and the phase z is obtained from the following equation:

$$\tan z=\frac{M.R}{E-M.m^2}$$

Each member of the solving equation corresponds to a certain periodical motion. The period of the first member agrees with that of the operative force. The motion denoted by this expression thus reproduces the same tone that caused the undulating current, and thus denotes the so-called "compulsory" motion of the diaphragm. The number of vibrations of the second motion is

$$\frac{\sqrt{E^2-\frac{1}{4}R^2}}{M}$$

It is independent of the number of vibrations, m, of the external actuating force, and is exclusively determined by the quality of the diaphragm, its mass, rigidity and elasticity. It represents the free vibration, or the individual tone of the diaphragm.

The harmful influence of the free motion through concomitant tones and after-vibrations has been already commented upon. Its amplitude is proportional to

$$e^{-\frac{1}{2}Rt/M}.$$

It will thus diminish as the time t, and will disappear more or less slowly according to the size of the quotient $\frac{R}{M}$. The larger this quotient, the more rapidly are the free vibrations damped. A favorable feature about telephone diaphragms in this regard is that their form causes atmospheric resistance—which forms a considerable part of the value R—to be very great. For the harmonic vibrations composing vowels, free vibration is sufficiently damped, as both the experiments of Frolich and common experience prove. It is only partially so for consonants, their curves of vibration being much more abrupt and irregular.

When after two or three oscillations the free vibrations are muffled, then only the compulsory vibration will remain, which, after a slight transmutation, will assume the following form:

$$u=\frac{A}{\sqrt{E^2+m^2(m^2M^2-2EM+R^2)}}\cos(mt-z),$$

from which we see that the amplitude u depends upon the number of vibrations m in such a way that it will decrease as the number of vibrations increases. Thus deep tones are reproduced proportionally more strongly than high ones. The greater the elasticity the less noticeable does this influence become, and in good

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diaphragms it may be wholly disregarded. These assumptions alone will make the statement true that the number of vibrations is proportional to the operative force.

In addition to the theory of the mechanical vibrations of the diaphragm, a knowledge of the theory of the electrical processes in the telephone is important to understand the mode of operation.

Let us conceive two telephones, one a transmitter, the other a receiver, connected with each other by two wires so that a closed circuit is formed. Let the resistance of the circuit be W and the combined self-induction constants of both telephones Q. The inductive electro-motive force is produced by changes of the magnetic field, that is, by the vibration of the magnetized diaphragm. If P be the electromagnetic potential, then the inducing electromotive force will be $\frac{dP}{dt}$ and we shall have the following equation (by Neumann) as determining the strength of the induced current:

$$\frac{dP}{dt} = JW + Q\frac{dJ}{dt}$$

When the diaphragm performs a simple harmonic vibration, $A \cos. mt$, and the electromagnetic potential has the following value

$$P = P_0 . A \cos mt,$$

then the electromotive force will be

$$\frac{dP}{dt} = P_0 . A . m . \sin mt,$$

and the following solution will suffice for the differential equation:

$$J = \frac{P_0 A}{Q\sqrt{1+\left(\frac{(W)}{Qm}\right)^2}} \cos (mt - z) = a \cos (mt - z)$$

in which the phase z is determined by the equation

$$tn\ z = \frac{W}{Qm}$$

The denominator of the equation for the amplitude a contains the frequency of vibrations n, and contains it in such a manner that as m becomes larger the denominator will become smaller, and the amplitude itself will, for this reason, become greater, and high tones will thus be relatively more strongly reproduced than deep tones, and transmission is, for this reason, not quite perfect, as the relative intensity of the separate partial tones is changed, and thus the timbre also. This change is smaller as the resistance is smaller and the self-induction of the circuit greater. To show this interdependence, the following table has been

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worked out, giving us as the relative amplitude of the transmitted tone for different resistances and numbers of vibration:

$$\frac{1}{\sqrt{1+(W/m)^2}}$$

supposing the self-induction $Q = 1.10^6$ cm. $= 1$ henry (unit of self-induction), as is frequently the case in actual practice. From this table it may be seen that in lines up to 100 ohms resistance high and deep tones are reproduced with equal force, but that with greater resistances there is a very unequal diminution. Thus, with a resistance of 10,000 ohms, the amplitude for a tone of fifty vibrations per second amounts only to the fifth part of the amplitude of a tone of 5,000 vibrations, and even the octave of the deepest tone is hardly reproduced with half the force of its fundamental. This, of course, greatly distorts the timbre, and intelligible conversation is made difficult or impossible. Then it must be borne in mind that tone force, which is of the highest importance in the matter of timbre, is proportional to the square of the amplitude. By increasing self-induction this difficulty ought, from a theoretical standpoint, to be obviated, and Heaviside laid special stress upon this point. But as yet we have no conclusive experiments on this question. It seems to be difficult to increase self-induction to the extent which is necessary without at the same time creating other troubles just as serious. The table also shows the influence of resistance upon the value of the amplitudes. The amplitudes of very high tones are slightly diminished by increasing resistance, but not to a degree which would correspond to Ohm's law. The harmful influence of great resistance is not so much that it weakens the tone generally as that low and high tones are so differently affected by it, in this respect.

Number of vibrations per second.	Resistance of the line in ohms.		
	100	1,000	10,000
50	0.95	0.48	0.17
100	0 98	0.61	0.24
500	1.00	0 87	0.48
1000	1.00	0.92	0 61
5000	1.00	0.98	0 87

(To be continued.)

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EDUCATIONAL COURSE IN TELEPHONY.

BY A. J. KUSEL.

Before taking up the description of the various types of storage batteries we can profitably expend a little time in the study of electro-chemistry, which, by the way, is one of the most interesting of the sciences, as well as one of the youngest. The attractive feature of electro-chemistry is due principally to the fact that each experiment brings forth results apparent to the eye and capable of being measured or weighed. It also is singularly free from the brain racking propositions which we frequently run against electricity, telephony and mathematics, where we are dealing with quantities which are either invisible or incapable of being isolated.

In order to avoid repetition it will be necessary to define the following special terms which are generally used in this art:

Electrolysis is the course of chemical changes caused by the passage of electricty through a chemical compound in solution or in a fused state. As matter in a fused state is not employed in primary or secondary batteries we will confine our experiments to solutions. The results of electrolysis are always manifested in the shape of a gas, a solid or a liquid, and frequently these three conditions are produced in a single experiment.

An electrolyte is a compound substance capable of being resolved into its constituent elements by the passage of electricity. In this article we will confine ourselves to liquid electrolytes.

An electrode is a conductor serving to convey electricity into or out of an electrolyte.

An anode is the electrode by which the electricity enters the electrolyte.

A cathode is the electrode by which the electricity leaves the electrolyte.

An ion is the term applied to the constituent elements of an electrolyte which are supposed to be the carriers of electricity, and may be composed of a single element or a combination of different elements. As an illustration, a single element ion may consist of hydrogen, oxygen, zinc or copper, and a compound ion may consist of a combination of oxygen and a metal forming an oxide of such metal, or a combination of oxygen and sulphur, as sulphuric acid; or a combination of oxygen and nitrogen, as nitric acid, etc. Ions are infinitesimally small and their products only are visible at the electrodes.

Anions are the ions or their products which appear at the anode.

Cations are the ions or their products which appear at the cathode. Ions are further classed as positive ions and negative ions; the ions appearing at the anode being negative to those appearing at the cathode. Generally metals or their oxides appear at the cathode, and non-metallic elements or their oxides, such as the acids, appear at the anode; there are, however, some exceptions to this rule, as will be shown in our experiments.

The apparatus necessary to carry on these experiments is very simple and inexpensive. All that is required is a few clear glass vessels of a capacity of an ordinary tea cup, some strips of sheet copper, lead, zinc, iron, carbon, etc., about one and one-half by three or four inches; a few ounces each of some of the common chemicals and acids, and a source of continuous current electricity. The most convenient means of obtaining the latter is from a continuous current incandescent lighting circuit, as we can put the electrolytic cell in series with a single lamp and obtain ample current to carry on the work in hand. Where it is necessary to use primary batteries the alkali-zinc-copper type of Edison-Lalande, Gordon or Nungesser, are the most convenient and require little or no attention. However any closed circuit battery may be used if it is kept in proper condition to deliver a steady current of a quarter to one-half of an ampere.

We will start with the separation of copper. Dissolve two ounces of copper sulphate in about six ounces of water and acidulate the solution with a few drops of sulphuric acid; place a strip of sheet copper at two opposite sides of the cell and bend the ends down over the edge to keep the electrodes in a steady position; the distance between these electrodes may be from one-half to several inches. Now

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connect the terminals of the battery or the lamp circuit to the electrodes, and in a short time it will be observed that the copper ions are being deposited on the cathode, and if the operation is allowed to proceed for a sufficient length of time the anode will be entirely destroyed and its contents carried to the cathode.

In this case we are dealing with two forms of ions, one a single element of copper, which is passing with the electrical current to the cathode, the other a compound element ion consisting of sulphur and oxygen (known in chemistry as a radicle, which is passing in an opposite direction, or against the electrical current, to the anode, which it attacks and forms a new molecule of copper sulphate, thus keeping our electrolyte at constant strength or density. This experiment illustrates the method of electro-plating copper, silver, nickel and other metals, as well as the method of electrolytic refining of copper, which is now used on an enormous scale for the production of pure copper for electric conductors.

We will now repeat this experiment with an anode of carbon, instead of copper, all other conditions remaining the same. The copper ions will again appear at the cathode, as in the previous operation, but two new conditions soon become apparent; the electrolyte gradually becomes discolored and bubles of gas appear at the anode, and if the operation is prolonged gas will also appear at the cathode. Upon investigation of these changes we find that the electrolyte, which was originally a solution of copper sulphate, is now dilute sulphuric acid, and that the gas given off at the anode is oxygen, and that from the cathode is hydrogen. Our list of ions has increased, as we now have single element ions of copper, hydrogen and oxygen, and, in addition, a compound ion consisting of sulphur and oxygen, apparently a complicated proposition, nevertheless one that is easily explained. We know that copper sulphate is composed of 63 parts of copper, 32 parts of sulphur and 64 parts of oxygen; we also know that water is composed of 2 parts of hydrogen and 16 parts of oxygen. Our copper cathode has increased largely in weight, and as our only source of copper is from the copper sulphate, it is evident that decomposition has been caused by the electric current. The existence of sulphuric acid in the electrolyte is demonstrated by the fact that we find no trace of sulphur, showing that the compound ions of sulphur and oxygen resisted decomposition. The presence of oxygen and hydrogen proves that some water has been decomposed by the current, as we have no other source of these elements. These results show that an electrolyte of complicated constitution may be split up into its component parts by means of electrolysis; that the metals will be deposited in a certain definite place; that the gases, oxygen and hydrogen will be evolved at the anodes; that an acid radicle, such as sulphuric acid, will under proper conditions, resist decomposition, and that we have a cheap source of oxygen and hydrogen gases in water. It is also shown that the metal ions travel in the same direction as the current; that the hydrogen gas ions follow the metals in this respect; that the oxygen gas ions travel in an opposite direction to that of the current, and that the acid radicle ions follow oxygen in direction but without decomposition.

Similar results will follow in the electrolysis of numerous other metals, providing we select the proper solvent. With gold and silver is found that potassium cyanide gives the best results; with nickel the double sulphate of nickel and ammonia is used, and with iron the double chloride of iron and ammonium is suitable, also the double sulphate of iron and ammonium. These double salts of the metals named are practically mixtures of two salts in the proportions of their atomic weights. To illustrate the nature of such compositions we will state the constituent parts of the last named salt; iron 56 parts, combined with 32 parts of sulphur and 64 parts of oxygen, and 36 parts of ammonium combined with 32 parts of sulphur and 64 parts of oxygen. If, in order to check the correctness of these figures, we should make an electrolyte containing one ounce of the crystals of the double sulphate of iron and ammonium and deposits its iron contents by means of electrolysis, we will find on

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weighing the result that the iron runs considerably short of these figures; this is due to the fact that in the act of crystallization considerable amounts of water are taken up, which is termed the water of crystallization, and varies with different salts; with the above proportions of iron and ammonium sulphate 108 parts of water must be added, thus reducing the percentage of iron contained in the ounce of salts we have electrolysed. There is still another feature which will affect the figures on our deposited iron, as well as change its physical qualities, this is that the hydrogen ions are deposited on the cathode along with the iron ions, forming a combination of iron and hydrogen. This does not, however, make a great difference in the weight, as the specific gravity of hydrogen is extremely small, but with the physical qualities the difference is very pronounced, the irons being much harder than the iron we have taken from the anode to replace that deposited. If this deposited iron is now heated sufficiently to drive off the hydrogen we will find the iron to be as soft or softer than the metal in our anode. This quality of electro-deposited iron is two salts of the metals named are practically mixtures of two salts in the protaken advantage of in the socalled steel plating of copper electrotypes for printing purposes in order to secure a harder surface. It is probable that the same action takes place in the deposition of some other metals, as nickel is noticeably harder when obtained by electro-deposition.

We will now study the action of lead electrodes immersed in dilute sulphuric acid. Prepare the cell with sheet lead anode and cathode. Make the electrolyte by adding half a fluid ounce of ordinary sulphuric acid to five ounces of cold water. An earthen vessel should be used, as considerable heat is generated. When cooled it is ready for use. Connect up with the source of electricity and observe results. We find that gas is being evolved at both electrodes; that at the cathode being hydrogen and that at the anode is oxygen. It is evident that hydrogen is traveling with the current, as in previous experiments, and that oxygen flows against or in the opposite direction to the current. The surface of the cathode is brightening, as though scoured, and appears lighter in color, but there is no evidence of metallic lead being deposited. The anode is changing color, and is decidedly brown or chocolate colored, and apparently increasing in bulk. These conditions continue throughout the experiment, the anode gradually getting darker colored and increasing in thickness. Why do we not get a deposit of lead on the cathode? The reason is we have no lead in the electrolyte, as sulphate of lead is nearly insoluble in this solution (about 1 part in 25,000), and any action of the sulphuric acid on the lead of the anode is confined to that electrode and remains as a deposit of lead sulphate, or is decomposed by the liberated oxygen into oxide of lead and sulphuric acid, consequently the electric energy is expended in decomposing water and liberating hydrogen and oxygen.

The electrolyte is practically unchanged, as the sulphate of lead formed at the anode is broken up by the oxygen as fast as formed, thus making good the loss of sulphuric acid. There are, however, some slight losses due to the formation of persulphuric acid, a modified form of sulphuric acid and of unstable nature. There is also some formation of peroxide of hydrogen in the electrolyte. The brown oxide of lead formed on the anode is termed peroxide and consists of one equivalent of lead and two equivalents of oxygen, or by weight 207 parts lead and 32 parts oxygen. Lead and oxygen combine to form lower oxides than the peroxide, as we have red lead, composed of two equivalents of lead and three equivalents of oxygen, and litharge, which is composed of one equivalent of each, or by weight 207 parts lead and 16 parts oxygen. This is one of the qualities of lead which make it valuable in the construction of a storage battery. We will now detach our circut and reverse the direction of the current through the cell, which will make the original anode a cathode and the former cathode our present anode. What is observed? An evolution of oxygen gas at the anode, but the cathode is now apparently doing

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nothing. We are decomposing water exactly as before and the liberation of oxygen at the anode proves it. Where is the hydrogen going to? We will see very shortly. Our anode is changing color, and the same brown oxide is covering it up as before, while our cathode is losing its pretty chocolate color and getting a dirty gray tinge. We have found where the hydrogen is going to. It is traveling with the current as usual, and being liberated at the cathode, where it decomposes the lead peroxide, forming water and a spongy form of metallic lead, consequently it will be invisible until it has broken up all of the lead peroxide on the cathode.

Let the current continue to flow through the cell for some hours, then detach the circuit and connect the cell with an ammeter or common galvanometer. We have a considerable current flowing. Try the electro-motive-force with a voltmeter, and you will find that it shows two volts. Let the current flow as long as it will, then open the circuit and let the cell stand for about twenty-four hours. We find the color of the peroxide electrode has become much lighter and that small specks of dirty white lead sulphate are numerous on both electrodes. The sulphuric acid has been at work while there was no current flowing to counteract it, and if allowed to stand in this way for a sufficient length of time the peroxide of lead on the anode and the spongy metallic lead on the cathode will finally be converted into lead sulphate. We have here all of the elements of the original Plante accumulator, or storage battery, but it will take a long period of such charges and reverse charges to bring its capacity up to a commercial basis.

We will now show how both the peroxide of lead and spongy lead may be obtained at one operation. Prepare the electrolyte by dissolving two ounces of caustic soda in five or six ounces of water, heat to boiling, and add half an ounce of litharge—lead monoxide. When cooled pour into the electrolytic cell and insert anode and cathode. Shortly after the current has commenced to flow we find a brown coating of lead peroxide on the anode and a loose deposit of spongy lead on the cathode. If the temperature of the electrolyte is raised to about 160 degrees Fahrenheit we will get a deposit of red lead instead of peroxide of lead on the anode. The chemical and electrical action here is similar to the others we have carried out; water is decomposed by the current, the oxygen passing to the anode to form an oxide of lead, and the hydrogen traveling with the current takes the oxygen from the litharge to form water. The metallic lead ions thus released going to the cathode to form spongy lead. This process has been used on a commercial scale to form lead plates for storage batteries, it is said, with good results.

In these experiments no account has been kept of the electro-motive-force, and if primary batteries had been used as a source of electricity, each combination would have required a different voltage. In the first experiment the simple deposition of copper requires very little e. m. f, one alkali--zinc-copper cell having seven-tenths of a volt being ample, while in the others three to four of such cells would be required, as it takes nearly one and one-half volts to decompose water, and other actions going on would raise the e. m. f. to nearly three volts. If a voltmeter is at hand it will be interesting to measure the voltage in each case. (To be continued.)

RENEWING OLD WALNUT BACKBOARDS.

To give black walnut a fine polish, so as to resemble rich, old wood, apply a coat of shellac varnish, and then rub it with a smooth piece of pumice-stone until dry. Another coat may be given, and the rubbing repeated. After this a coat of polish, made of linseed oil, beeswax and turpentine, may be well rubbed in with a dauber, made of a piece of sponge tightly wrapped in a piece of fine flannel several times folded, and moistened with the polish. If this work is not fine enough, it may be smoothed with the finest sandpaper, and the rubbing repeated. In the course of time the walnut becomes very dark and rich in color, and in every way is superior to that which has been varnished.

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Telephone Magazine

THE ONLY INDEPENDENT TELEPHONE PAPER IN THE WORLD.

TEL. CENTRAL 2641. MARQUETTE BUILDING, CHICAGO.

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JOHN C. McMYNN, PRESIDENT.

No corporation, firm or person either directly or indirectly interested in the production or sale of telephones or telephone materials of any sort has any connection editorial or proprietary, with this publication.

Telephone Money Orders.

The telephone has been suggested to be used like the telegraph for the speedy transmission of funds or telephone money orders.

A number of leading telephone men have passed their opinion upon this subject. Some say that the telephone wires being public, and, therefore, open to the public, while the telegraph wires being private, are in the hands of a company, make the plan impracticable.

This opinion is due to the fact that they evidently did not give the plan much thought. For undoubtedly the telephone offers a more feasible means of the transmission of funds than the telegraph for a more minute description of the payee, may be given over the telephone in a more readable manner, than over the telegraph, and then, again, the fact that a trained telephonists' ear may readily recognize a voice, this prevents tapping of the wires, which has resulted in the loss of considerable money by fraudulent means by the telegraph companies.

The parties at the receiving end would be able to know at once whether the order to pay an amount of money was authentic or not. This makes the telephone superior to the telegraph in still another point.

A word; let the independents be first to inaugurate the system of "telephone money orders." As they lead in point of service let them lead in this.

Superiority of Girls as Telephone Operators.

In its decision to employ girls as telephone operators, the British postoffice has paid another tribute to the superiority of women over men as operators of the thelephone.

From America to Japan, the telephone girl has a monopoly of this profession. The rapidly growing telephone service of Japan is staffed entirely by women. Germany has rejected women a telegraphists, but admits their superiority as telephonists.

All the large telephone companies in Europe and America employ women. This supremacy is a matter of voice.

A writer in a London exchange in commenting upon the action of the British

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postoffice sums up as the points of women's superiority:

"The vocal chords of a woman are considerably shorter than those of a man. As a result the voice has a higher pitch. The telephone diaphragm responds more accurately to the high-pitched voice, the magnetic disturbances are more rapid, and therefore more potent, and the currents transmitted to the remote station lose less in transmission.

"If you listen to an average woman speaking and compare her with an average man of her own class, you will notice the following among other things. Her enunciation of the words is better. There is lesser tendency to cut the ends of words or to drop the voice and mumble the terminations than is displayed by her male companion. Her choice of words, too, is better, and there is a natural purity of diction that is distinctive. She will use a larger percentage of the short, crisp, homely Anglo-Saxon words and show an avoidance of abstract Latin.

WORTH KNOWING.

To harden a steel tool for a special purpose, heat it to a cherry red, drive the point into a cake of lead and leave it there until it is cold. It will prove to be hard and tough.

Tempering of steel can be done in two ways, one by hardening it first on plunging into cold water and then drawing the temper, and the other by plunging the red hot steel into various liquids directly. The temperature of such fluids and their capacities of drawing off heat regulate the degree of temper obtained.

TO CASE-HARDEN CAST IRON.

Heat to a red heat, roll in a composition consisting of equal parts of prussiate of potash, sal ammoniac and saltpetre, pulverized and thoroughly mixed. Plunge while yet hot into a bath containing two ounces of prussiate of potash and four ounces of sal ammoniac to each gallon of cold water.—Shop Talk.

WIRELESSNESS.

Marconi, success. After just closing with the Lloyd Steamship Company what undoubtedly is the largest contract and carries more weight with it than any other wireless business arrangement heretofore seen or heard of, Mr. Marconi now startles the world through the daily press with the startling announcement that he has transmitted intelligence through space for a distance of over 1,700 miles. This test was made with a receiving station at St. Jonhs, N. F., from the Cabot Memorial Tower. No authentic description of the apparatus used could be obtained, and all I know was the intention of Mr. Marconi to visit New Foundland and make some tests with wireless telegraphy from balloons. When he reached St. Jonhs he was interviewed, and said, "My principal object is to make experiments, so as to ascertain the relative values of different positions along the coast, with a view of locating one of our stations near St. Johns. I have brought with me two balloons of about 15,000 cubic feet capacity. They will be used to suspend the vertical wire, and should be valuable for experimenting on account of their portability. The ordinary pole used in permanent stations is about 100 feet high, weighing about 5 tons, and would consequently be difficult to carry one around for experimental purposes. It is proposed to make the first tests at Signal Hill, from the Cabot Memorial Tower, where the government has allowed me the use of two rooms for storage of my apparatus.

"In making these experiments I shall closely study the rock formation of the coast, as if it is found that good results can be obtained in New Foundland the knowledge gained about the physical character of the ground will be a guide to me in locating stations elsewhere. One has to study geology very closely in these matters. Before erecting a plant it is necessary to test the ground thoroughly and ascertain whether the soil is suitable, as certain kinds of rock formation are more favorable than others." This is all I had heard or read of. Then came a cablegram from Marconi stating that he had telegraphed across the Atlantic Ocean

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without wires. A series of experiments just concluded resulted, he says, in complete success. For three days, at hours prearranged, the instrument erected near here, on the coast, clicked off the letter "S" of the Morse code at regular intervals for three hours on each day.

Marconi says he has demonstrated the feasibility of sending telegraphic signals across the ocean without wires, and he is continuing his experiments in the belief that before long complete messages will be sent back and forth across the sea by his wireless system.

The station on the other side of the Atlantic is the regular Marconi establishment on the Cornwall coast. I have arranged to have a representative at the test to be given by Mr. Marconi in the latter part of December, and I will then be able to tell my readers if it was done, and how.

At a dinner, Mr. Marconi said: "If my system of wireless telegraphy can be commercially established between different parts of the earth—of the possibility which I may state I have not the slightest doubt—it would bring about an enormous cheapening of the methods of communication." Then, referring to the current rate of 25 cents per word for cabling to England, he said: "I do not see why eventually, with the wireless system, this cost would not be reduced to 1 cent a word, or less. It may be the fear of some such reduction that caused the Anglo-American Cable Company to notify me to cease trespassing on what that company alleges are its executive rights and to abandon my wireless telegraph tests between New Foundland and England. Unless that corporation has been panic-stricken it would not have been guilty of so foolish a performance as to attempt to put a veto on the continuance of experiments which are so interesting and so promising of great results.

"Progress in means of communication and interchange is almost synonymous with progress in civilization. and the significance of the reduction suggested in the cost of transmitting intelligence across the oceans—which seems likely to be the earliest, though not necessarily the only, domain of wireless telegraphy—is hardly to be estimated. Such a reduction would release commerce from a tremendous burden of expense and would advance its comprehensive organization. It would facilitate all travel and would multiply those international ties of business and acquaintance, which are the best guarantees of general peace. It is interesting to imagine what would be the newspaper of time when the news of all parts of the earth would be interchanged without the expensive cable or any other connecting apparatus between continents.

"Ideally, a properly correlated glode would be one in which the thoughts and deeds of all people would, on the instant, become universally accessible. Such pervasiveness of information would mean a globe whose functions were organized t a degree of responsiveness and economy quite unknown to-day.

"If my expectations are even approximately fulfilled, human progress, solidarity and peace will be immeasurably forwarded through wireless telegraphy."

One hundred miles is a great distance at the present stage of the art for a message to travel through space. Mr. Marconi claimed, a short time ago, that he did not think the distance could be increased to present known methods to over 300 miles, and now he comes forth with the startling news, that almost staggers imagination, with the announcement that he has telegraphed through space a distance of over 1,700 miles.

In a press dispatch from England, it says: "At the headquarters here of the inventor of wireless telegraphy, it was told told by officials in charge that the experiments at St. Johns, so far as they know, are all over. They do not expect to hear any further details until Mr. Marconi arrives in London. It was said that storms on both sides of the Atlantic had seriously interferred with the work, which the officials claim would have been much more satisfactory under normal weather conditions, the Poldhu, Cornwall, station having been seriously damaged by high winds."

The officials at Poldhu refuse to confirm or deny the truth of reports from St. Johns that messages have been received

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there from Cornwall by wireless telegraphy. They profess complete ignorance of the success or failure of the experiments.

American scientists are divided on the question of accepting Marconi's statement of his wonderful accomplishment.

Edison says that he does not believe it, because he knows Marconi is a practical business man, and he feels sure that he would make a statement to the public over his signature if the story were true.

Prof. G. W. Hough, of the Northwestern University, says he is a little skeptical about Marconi's ability to construct instruments sensitive enough to record signals at such a great distance.

Prof. A. A. Michelsen, of the University of Chicago, says that he does not believe that wireless telegraphy will succeed, in commercial copetition, with the present system, even if Marconi's present claim is true.

Mr. Carl Kinsley, of the Army Board, which reports on Marconi's system to the government, says: "From what I know personally I place the utmost confidence in any of Marconi's announcements. I believe that it is merely a question of time and sufficient power when messages will be sent across the ocean without wires. If Marconi had not asked such exorbitant royalties the government would be using his system in the army to-day."

Mr. Glenn Moody Hobbs, instructor in physics, says he doubts the practicability of Marconi's latest experiment; that theoretically it is a magnificent achievement, "but it was not a message, it was only a signal."

Mr. Henry Gordan Gale says that he believes that Marconi has accomplished what he announces, and that he felt sure that Marconi would succeed in time. He says, however, that, in his opinion, atmospheric interference will make transmission of messages practically impossible. I hesitate before expressing my opinion in this matter, but it does not seem to me hardly possible. With the present apparatus employed to-day, and I have no proof that Mr. Marconi used other than the same style that has been used in most other experiments.

TELEPHONE SYSTEMS IN PRIVATE HOUSES.

The private house of to-day, instead of being equipped with a speaking tube, as was the custom a few years ago, generally has a modern telephone system connecting the various departments with each other. The main advantage of the telephone over the speaking tube is that one outlet or one 'phone can be used to communicate to all of the different stations, whereas when the speaking tube was used, a separate mouthpiece was needed for each and every station. In locating these outlets for the telephone, great care should be taken in placing them where they will be most convenient for the use of the household and also where they will not interfere with any of the fittings of the house which are to be installed at a later date, such as radiators, sideboards, etc. A very convenient place is near the casing of the door, as it is almost impossible to place any heavy article of furniture near a door. Caution should be used in first discovering which way the door is to swing.

The wire cable which is used in connecting the various stations should run as far from the water pipes as possible, on account of breaks in the pipes which are liable to occur, and the moisture from which would injure the wires, make cross-connection, cause leaks of current and soon destroy the vitality of the battery. A cable having a weather-proof insulation is preferable, not only on account of the properties which prevent moisture from entering the same, but also because a cable of this kind is not attacked by rats or mice. These animals gnaw the insulation, and while they do not injure the wires in the ordinary cable, they frequently cause crossing or grounding of wires, which is difficult to locate and is very annoying both to the owner and the electrician.

Wall pockets or receptacles for holding the telephone are very useful at the outlets, for while keeping the telephones fully covered they do not deface the walls, and by their use many of the connections can be made inside and a buzzer or a bell can be placed within for the purpose of calling that station.

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TELEPHONE NEWS.

ARKANSAS.

HARRISON, ARK.—E. Kimbley has purchased all the telephone lines west of Harrison, from the Ozark Telephone Co. Consideration, $10,000.

MOUNTAIN VIEW, ARK.—Mr. G. R. Case, of Mountain View, will build three miles of private telephone line to his farm.

PINE BLUFF, ARK.—The telephone line recently begun by the Arkansas River Telephone Co., has been completed by the Valley Telephone Co., and connection was made and the line is now in use and is giving good service. The new line will give Pine Bluff direct connection with the following places: Redfork, Pendleton, Medford, Lenox and Cox's residence. The Valley Telephone Co. will probably, in future, build a line to Star City.

WASHINGTON, ARK.—The Hope Telephone Co. wants to construct a telephone system in Washington.

CALIFORNIA.

CARUTHERS, CAL.—Wheatville Telephone Co. Principal place of business, Caruthers, Fresno county. Directors—F. M. Miller, H. A. Monson, W. G. Grove, J. W. Downing and H. A. Adams. Capital stock, $5,000; subscribed, $2,014.

SANTA MARIA, CAL.—A telephone line is being constructed from Santa Maria to Carey, a small town ten miles up the valley.

CAROLINAS.

CARLISLE, S. C.—A charter was granted the Carlisle Telephone Co., of Carlisle, Union county; capitalized at $600. The officers are W. E. Ratchford, president; L. B. Jeter, vice-president and W. H. Gist, secretary and treasurer.

FAYETTEVILLE, N. C.—A combination is reported of all the telephone companies from Fayetteville to Washington, N. C., to be known as the Carolina system, with Howard F. Jones, of Wilson, N. C., as general superintendent. The exchanges included are: Wilson, with toll lines; Fayetteville, Tarboro, Scotland Neck, Greenville, Kinston, Goldsboro and Washington. Henderson and Rocky Mount are said to be the only towns not included.

RALEIGH, N. C.—Extensive improvements in its plant are soon to be made by the Interstate Telephone Co.

WILMINGTON, N. C.—The Interstate Telephone Co. is erecting a line to Old Brunswick, twenty miles down the Cape Fear river.

DAKOTAS.

BERESFORD, S. D.—George Skinner, Ferdinand Drey and Andrew Johnson have been elected as a board of directors for a new telephone company at this place, with power to complete the organization. As soon as a franchise is granted the organization will be perfected and the line built.

ELKTON, S. D.—The town council has granted a franchise to H. A. Brown, a local business man, for the establishment of a local telephone system. The franchise covers a period of fifteen years, and limits the monthly charge for telephones to $1.00 for residences and $2.00 for business houses. The system must be in operation within 150 days or the franchise becomes void.

HURON, S. D.—A new telephone line will at once be constructed connecting LaDelle, Lake Byron, Sheffield and other suburban villages with this city. President Zeitlow, of the Dakota Central Telephone Co., has the work in hand.

KIMBALL, S. D.—Brule Telephone Co., Kimball; capital, $50,000; incorporators, M. A. Willy, H. W. Heinrichs, H. S. Stuver, E. P. Ochsenreiter and C. S. Blodgett.

ILLINOIS.

BUNKER HILL, ILL.—Bunker Hill Telephone Co. Increased its capital stock from $2,500 to $10,000.

BRADFORD, ILL.—A new telephone line is being put in at Castleton, which is to connect with Bradford, Modena, Snareville and Valley.

BLOOMINGTON, ILL.—The third annual meeting of the stockholders of the McLean County Telephone Co. was held. The election of two directors, to serve a term of three years, resulted in the choice of Frank Garver, of Farmer City, and F. Y. Hamilton, of this city, to succeed themselves. After the stockholders' meeting, the directors held a session and re-elected all the old officers, as follows: F. Y. Hamilton, president; W. H. Johnson, secretary and treasurer; Edward T. Martin, manager and bookeeper.

BLOOMINGTON, ILL.—J. A. Smith is putting in a new telephone line from here to Delana. It will be completed in a short time.

CARBONDALE, ILL.—Farmers near Carbondale have organized a secret society, known as the Farmers' Economic Union, and have secured a franchise to operate a telephone system.

CHAMPAIGN, ILL.—Arrangements are being made to put in about 3,000 feet of new cable by the Home Telephone Co.

CHICAGO, ILL.—Papers were sent to Springfield from Chicago for the incorporation of the Automatic Electric Co., with a capital of $2,000,000. It has secured manufacturing rights for the United States and the plant of the Strowger Automatic Telephone Exchange.

CHICAGO, ILL.—Mr. Henry Shafer has resigned his position as general manager of the

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Stromberg-Carlson Telephone Manufacturing Co., and as secretary and treasurer of the Continental Construction Co., to accept the position of president of the International Telephone Manufacturing Co., Clinton and Harrison streets, Chicago. Mr. Shafer has been closely identified with the independent telephone business since its opening. He has been actively connected with the Stromberg-Carlson Telephone Manufacturing Co. since its organization. Previous to that he was in the purchasing office of the Chicago Telephone Co. for about five years. The International Telephone Manufacturing Co. will have a full line of apparatus for large and small exchanges for generator-call and central-energy systems. Mr. Shafer retains his position as secretary and a director of the Municipal Signal Co., 204 Dearborn street, Chicago.

CHICAGO, ILL.—H. C. Dodge Electric Co., Chicago; capital, $1,000; manufacturing electric telephone and telegraph supplies; incorporators, Max I. Heldman, Stanley Kubreener, William T. Rafferty and H. C. Dodge.

CHICAGO, ILL.—The Independent telephone system of Elgin, Joliet and Aurora is to be used as a nucleus for combining all the independent lines in the West into one consolidation. The principal owners of the Northwestern Telephone Co., operating lines in the Fox river valley, are among the incorporators of the Interstate Independent Telephone & Telegraph Co., which has just received a charter in New Jersey authorizing a capital of $3,000,000 and bonded indebtedness of $9,000,000. The purpose of this company is stated to be the unification of all independent systems in the West, and probably ultimately to reach into the East.

DECATUR, ILL.—The certificates of incorporation for the Niantic & Harristown Telephone Co. was filed in the office of the circuit clerk. It is stated in the papers that the purpose of the corporation is to build, erect and maintain a telephone line from Harristown and Niantic to Decatur and to run telephone lines in any part of Macon, Christian, Logan and Sangamon counties. The capital stock is $2,400. The commissioners to whom the certificate is issued are D. Buckles, Walter Pritchett and John B. Camp. The directors named are John B. Camp, Walter Pritchett, Lawrence Delaney, J. F. Beall and C. A. Hall. The stock is held by the following persons: D. Buckles, John B. Camp, J. G. Willard, Charles Finson, L. Delaney, Dr. A. Hall, James Connaghan and C. A. Hall, $200 each, and James Delaney, George Jacobson, Walter Pritchett, N. A Mansfield, J. B. Beall and Arthur Pritchett, $1,000 each.

EMDEN, ILL.—Rural telephone lines, connected at Emden with the Logan County Mutual Telephone Line, have established a central office in Emden.

EL PASO, ILL.—The new El Paso Telephone Co. will soon be in operation and, when finished, will furnish connection with a great many farmers in all directions.

FREEPORT, ILL.—Bills & Worthan have been granted the right to construct a telephone system in Freeport. The ordinance is a twenty-year one. It provides for underground conduits in the fire limits and for a rate not to exceed $24 per year for business telephones and not to exceed $18 for residence telephones, with concessions from these rates for party lines. The ordinance provides for all the latest improvements and for the remodeling of the system from time to time to keep it thoroughly up-to-date.

FULTON, ILL.—There is trouble in the independent telephone companies in West Fulton. The London Mill village board has ordered Dr. Beer, president of the Fairview and London Mills line, to move all poles and wires of his company outside the corporation within thirty days.

GALENA, ILL.—A company known as the Duke's Prairie Telephone Co. has been organized to build a telephone line from Waldwick to Mineral Point via Defiance.

GREENVILLE, ILL.—The city council of Greenville held a special meeting and granted a franchise to Messrs. J. H. Steinhaus, E. B. Denison, Christ Busse and John Gernot to operate their telephone lines in the city of Greenville for a period of twenty-five years. The franchise was granted by a unanimous vote of the city council.

GRIGGSVILLE, ILL.—Farmers' & Merchants' Union Telephone Co.; location, Griggsville; capital stock increased from $2,500 to $20,000.

HARRISBURG, ILL.—Harrisburg & Eddyville Telephone Co., Harrisburg; capital, $1,500; operate a telephone system; incorporators, J. A. Robertson, J R. Baker and J. N. Hart.

HIGHLAND, ILL.—Mr. J. H. Steinhaus has secured a franchise to erect and maintain a telephone system in this city.

JOLIET, ILL.—Directors of the Interstate Independent Telephone & Telegraph Co., a new $3,000,000 corporation recently organized in New Jersey for the purpose of acquiring and controlling telephone companies, held their first business meeting here. Directors were present from New Jersey, Ohio and Illinois. Officers were elected as follows: President, Senator H. H. Evans, Aurora, Ill.; vice-president, Frank Tracey, Springfield, Ohio; secretary and general manager, E. R. Conklin, Joliet; treasurer, A. B. Conklin, Aurora.

LA SALLE, ILL.—The Borough County Telephone Co. has increased its capital stock to $120,000.

LEXINGTON, ILL.—Levin Hyneman, manager and owner of the Home Telephone Co., is extending the telephone line into the country surrounding Lexington. The Home Co. has one of the finest exchanges to be found in a small town in this part of the state, and the new line will make a fine service. A line is being completed running six miles southwest. The material is purchased for a line running seven miles west and for a line running along rural route No. 1, through Lawndale township.

MATTOON, ILL.—The Farmers' Mutual Tele-

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phone Co., of Coles county, Mattoon; capital, $10,000; to operate a telephone system; incorporators, J. F. Miller, J. F. Brewster and A. G. Hildreth.

MARTINSVILLE, ILL.—The Martinsville Telephone Co. has dissolved.

NORMAL, ILL.—The Home Telephone Co. has, in Normal, nearly one hundred 'phones, and the hundreds of messages received and sent each day keep the Normal exchange busy. Miss Julia Maxwell is day operator, and Mr. Henry Stice is now filling the position of night operator. He is a student at the university.

OAK PARK, ILL.—H. D. Maize, a capitalist of Oak Park, has purchased the Harrison Telephone Exchange and system in Deadwood, S. D., the cost being slightly over $100,000. Mr. Maize has been in the Black Hills for several weeks to settle the bargain and secure the exchange.

PEKIN, ILL.—The Citizens' Telephone Co. has filed articles of incorporation in the sum of $50,000.

PEORIA, ILL.—An independent telephone system is being constructed by the Celestial Mutual Telephone Co.

PITTSFIELD, ILL.—Ed. Pendleton has completed his metallic circuit telephone line to Pittsfield. At Pittsfield the line joins the one owned by Mr. Glandon, of that city, and makes a complete metallic circuit to Louisiana, Mo.

REYNOLDS, ILL.—All the telephones centering at Reynolds have organized into a new concern, to be known as the Reynolds Independent Telephone Co. Their constitution and by-laws are ironclad in reference to not having any exchange with the Bell Telephone Co., or any other telephone system of the tricities. The officers are M. Schoonmaker, president; William Wheaton, vice-president; Robert Wait, secretary and John McAdams, treasurer.

ROSEVILLE, ILL.—The stock books of the new Roseville telephone company are open at the State Bank. Shares are $10. Stock to the amount of $2,000 will be sold.

SHERRARD, ILL.—The Sherrard Telephone Co. has been incorporated, with a capital of $2,500. The incorporators are J. C. Vernon, L. R. Treyo and H. E. Sudlow.

STAUNTON, ILL.—The manager of the Staunton Telephone Co., Mr. Williamson, informs us that its Western Construction Co.'s apparatus has switchboard capacity of 200 drops. It has 140 subscribers and a large number in prospect. The company only commenced operations Jan. 1, 1891.

STREATOR, ILL.—The officers and stockholders of the Streator Independent Telephone Co. met and it was voted to increase the capital stock to $100,000. The company will use the additional funds in extending and bettering the service in this city, and it is expected that during the coming summer to push the work on the farmers' lines and also to the surrounding towns.

WEST JERSEY, ILL.—The Stark County Telephone Co. is extending its line from Goshen to the village of West Jersey. The people of West Jersey have long needed telephone connection with the outside world, and the extension will be a benefit to the entire county. The work will be pushed as rapidly as possible.

INDIANA.

ANGOLA, IND.—The Farmers' Telephone Co., of Steuben county, has been incorporated with a capital of $1,500.

BLUFFTON, IND.—The United Telephone Co. has awarded the contract for the underground and the aerial cable systems for their new plant at Marion to F. B. Bissell, of Toledo, Ohio, and J. F. Butterfield, of Chicago. The contract amounts to $40,000. There will be 60,000 feet of underground and 50,000 feet of aerial cable work.

CONNERSVILLE, IND.—The Connersville Telephone Co. increased its capital stock from $25,000 to $50,000.

ELWOOD, IND.—A franchise for an independent telephone system was granted to George W. Beers and others by the Elwood council.

EVANSVILLE, IND.—The Grandview & Chrisney Telephone Co. has been incorporated with a capital stock of $5,000. The incorporators all reside in Spencer county.

INDIANAPOLIS, IND.—Indiana Central Telephone Co, Putnam county; capital, $300. Directors—John Gemis, W. D. Bowers, John Wilson, James Goff and Fletcher Goff.

JEFFERSON, IND.—A telephone company has been organized at Jefferson, with Harry Heavilon, president; Allen Thompson, vice-president; Joseph Allen, secretary, and Addison Hart as treasurer. The work of constructing the system is to begin at once. It will connect with Frankfort.

MILLVILLE, IND.—The Millville Telephone Co. is extending its lines in various directions, and will soon connect with Mooreland, Blountsville, Greensfork and New Castle.

NEW CASTLE, IND.—The Mooreland Rural Telephone Co. incorporated. Its capital stock is $1,050, and the directors are Warren E. Moore, Harvey L. Williams, Fernando Chamness, Joseph A. Mouch and Nathaniel E. Lewis.

RENSSELAER, IND.—The Halleck Telephone Co., of Rensselaer; capital, $10,000. The company will construct telephone lines in Jasper, Newton, Benton, White, Tippecanoe, Warren, Carroll, Cass, Pulaski, Starke, Fulton, Marshall, St. Joseph, Laporte, Porter and Lake counties. Incorporators—Chas. Halleck, John F. Bruner, S. A. Wells, L. I. Halleck, Lizzie White, Abraham Halleck and Mattie Jayner.

SHELBYVILLE, IND.—John A. Tindell, of this city, is negotiating for the purchase of the plant of the Mutual Telephone Co., the company that was organized by local capitalists, in opposition to the Bell plant.

SULLIVAN, IND.—The Sullivan Telephone Exchange will be connected with the independent system, at Terre Haute, within the next three or four weeks. The new connection will give their patrons 119 additional tolling

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stations, and connection with 3,800 'phones in Terre Haute.

UNION CITY, IND.—Union City Telephone Co.; increase of capital stock from $30,000 to $50,000.

WASHINGTON, IND.—The Independent Telephone Co. has received a franchise from the city council. In order to secure a franchise the Independent Telephone Co. guarantees free service until it has 300 subscribers.

IOWA.

ANAMOSA, IA.—The Jones County Telephone Co. has been incorporated at Anamosa, with $50,000 capital stock.

BLANCHARD, IA.—A mutual telephone company has been formed here, with a capital stock of $1,500.

COIN, IA.—The Coin & Northboro Telephone Co., of Coin, Page county, has filed articles of incorporation. Its capital is $7,000. The incorporators are: W. T. Uttvitts, John H. Roll, F. E. Bryant, Lewis Harris, John Haisch, J. R. Harris, J. K. Herron, J. F. Whitmore and Ed. F. Rose.

CEDAR BLUFFS, IA.—The new telephone line from Cedar Bluffs to Solon will soon be completed.

CEDAR RAPIDS, IA.—Within the next three months the Iowa Telephone Co. will spend between $50,000 and $60,000 in improving its plant and its service in this city.

CEDAR VALLEY, IA.—The Cedar Valley Telephone Co. has a force of men to work in the city putting up new poles. The company will considerably increase the value of the local exchange and make it cover a wider territory.

CEDAR VALLEY, IA.—F. H. Eckles, of Tama county, has purchased the Cedar Valley Telephone Co., which runs into Shell Rock.

DAYTON, IA.—A local telephone company has been organized here and will be a much needed benefit to the city. About $2,000 has been subscribed and over sixty 'phones have been ordered. The work of putting in poles and stringing wire will be started as soon as help can be obtained. The company will connect with the Martin and Fort Dodge systems, and thereby give the local residents good service throughout the county.

DES MOINES, IA.—The Morning Sun Telephone Co. has filed articles of incorporation with the secretary of state. Its capital is $10,000. Fred Courts is president.

DES MOINES, IA.—The Farmers' Mutual Telephone Co., of Johnson county, has filed articles of incorporation with the secretary of state. Its capital is $4,500. Noah Yoder and others are the incorporators.

ELDORA, IA.—The Rough Woods Telephone Co. held a meeting. They are going to put in a new line at once, under the same management.

EMERSON, IA.—The Iowa Telephone Co. bought the Baird telephone interests in this county, and took possession of the line.

GOWRIE, IA.—A telephone exchange of probably fifty 'phones will be placed in the little town of Gowrie, a short distance south of Fort Dodge, in the near future.

GILMORE, IA.—The new telephone exchange of Gilmore is now in working order, and is proving very satisfactory.

GRINNELL, IA.—The stockholders of the Interior Telephone Co., at their late meeting, elected officers as follows: J. P. Lyman, president; C. W. H. Beyer, vice-president; Louis Middledorf, secretary; C. H. Brown, treasurer; J. M. Grimes, director. The headquarters of the company will be in Grinnell in the future.

GRAND VIEW, IA.—Chrisney & Grand View Home Telephone Co., Spencer county; the business to be carried on in Spencer, Perry, Warrick and Dubois counties; capital stock, $5,000. Directors—Loren F. Gage, G. J. Clement, D. S. Goble, J. P. Chrisney and T. E. Chrisney.

HOMESTEAD, IA.—A number of farmers of Iowa township have formed a telephone company. J. Ahrens, B. Sandersfeld and F. Pund were elected trustees; George Trimpe, treasurer, and J. W. Hild, secretary. Posts and wire have been ordered and the work will be started as soon as the material arrives.

KELLY, IA.—The farmers east of Kelly have organized a mutual telephone company, which will be known as East Kelly Farmers' Telephone Co. The line will run as far north as to Lewis Roe, and east to W. P. George. The prospects are that it reaches Ames in the spring. It will connect with the line south to Kelly, which enters Slater and Huxley.

KEOKUK, IA.—The Mississippi Valley Telephone Co., of Keokuk, has filed a deed for its lines in consideration of $300,000.

MANSON, IA.—P. C. Holodegel, of Manson, proposes to construct an independent toll system out of Des Moines, to compete with the Iowa Telephone Co. He plans a line from Des Moines to Gowrie, where it will connect with trunk lines already constructed, running to Sioux City, to Albert Lea, Minn., to Waterloo, and which have about 50 branch connections.

MOLINE, IA.—The Moline city council granted a twenty-year franchise to the Illinois Independent Telephone Co.

MURRAY, IA.—Murray has granted a franchise to the Southern Iowa Telephone Co.

OTTUMWA, IA.—C. M. McFatridge, manager of the Morazia Telephone Co., has sold to the Ottumwa Telephone Co., of this city, the franchise held by that company, giving it the right to erect and maintain a telephone system in Blakesburg. This franchise was voted to the Moravia Co. a few months ago. The Ottumwa firm will fulfill its part of the contract in a short time. There is already a long distance line into Blakesburg, and the new system will be a local one to work in conjunction with their toll system.

SIOUX CITY, IA.—The farmers between here and Oto are forming a $25,000 company to put in a co-operative telephone line from Sioux City to Piero, a new route. George Honrig-

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hause and D. Goodrich head the movement. The farmers plan to connect private 'phones all along the line.

ONAWA, IA.—The Monona Telephone Co. is preparing to extend its lines from Whiting to Sloan.

SIOUX CITY, IA.—The New State Telephone Co. have completed their line to Mapleton This New State Telephone Co. is backed by a capital stock of $100,000 with other resources, making the company practically unlimited as far as financial backing is concerned. They promise to give the people the best possible service, extending anywhere, except Sioux City, in the following counties: Woodbury, Carroll, Sac, Ida, Crawford, Plymouth, Monona, Green and Calhoun. It is only a question of time until a Sioux City exchange will be added.

SHARON, IA.—The Farmers' Mutual Telephone Co. of New Sharon, Ia., has filed articles of incorporation, with $4,500 capital stock.

TINGLEY, IA.—The Tinglev & Mount Ayr Telephone Co. of Tingley, Ia., has filed articles, showing a capital of $1,540. D. C. Tidrick is president, R. H. Morey, secretary, and William Fife, treasurer. The latter and M. F. Hannley and D. O. Imus are directors.

TEMPLETON, IA.—Mr. F. M. Wilson of Templeton will secure a franchise for a telephone system in Council Bluffs.

WILTON, IA.—The Wilton Telephone Co. has been incorporated with a capital stock of $3,000. Mr. J. M. Rider has been elected president; F. Maurer, vice-president, M. B. Nelson, secretary, and W. D. Harris, treasurer.

KANSAS.

CHANUTE, KAS.—Arrangements are being perfected to extend the telephone line from Fredonia to Chanute via Benedict, Rest and Vilas.

HUTCHINSON, KAN.—Hutchinson has a telephone war starting. An independent telephone exchange is almost ready to begin operations there. As a result, the Missouri & Kansas Telephone Co. has begun cutting rates, dropping to less than half the price formerly charged.

MERIDEN, KAS.—The Independent Telephone Co. is planning to build a line from Topeka to Meriden, which will open up connections between the Topeka line and the independent line reaching from Atchison to Meriden. This extension will add 3,000 'phones to the independent connections.

TOPEKA, KAS.—A submarine cable will shortly be laid in Topeka, under the Kansas river. It will carry the wires of Topeka's new telephone exchange to North Topeka.

SALINA, KAS.—The Salina Telephone Co., one of the first independent telephone companies in the state, has purchased the Slyvan Grove telephone exchange and toll line system and will begin immediately to complete the toll line from Waldo west to Plainville. It is thought that the line will be completed by the first of the year. The Salina Telephone Co. has lines extending in every direction out of Salina, and before long hopes to have direct connection with Kansas City.

KENTUCKY.

BLOOMFIELD, KY.—The telephone exchange at Bloomfield, Ky., has gone into operation.

BURNING SPRING, KY.—Articles were filed by the Burning Springs & East Bernstadt Telephone & Telegraph Co., of Laurel county, with $2,000 capital stock. R. M. Jackson is the chief stockholder.

FULTON, KY.—The West Kentucky Telephone Co., composed of Mayfield and Fulton capitalists, J. E. Wright, of this city, manager, filed articles increasing the capital stock from $20,000 to $30,000. This company is one of the most progressive in the state and is upon a paying basis and doing a profitable business over their lines connecting Mayfield, Fulton, Hickman, Clinton, Wickliffe and intermediate points.

JEFFERSONVILLE, KY.—The Scott county commissioners have granted a franchise to the Independent Long Distance Telephone & Telegraph Co.

LUDLOW, KY.—A report from Ludlow says that the Kentucky Telephone Co., which was recently incorporated, has elected the following officers: President, J. J. Weaver; vice-president, W. J. Savage; treasurer, William R. Schelfers. Arrangements will be made later for the manufacture of telephone instruments and a factory erected which will employ fifty men.

MADISON, KY.—The Scott County Telephone Co. will extend its line to Madison.

MINTONVILLE, KY.—From Mintonville to Humphrey a telephone line is being constructed. In Humphrey it will make connection with the Middleburg line.

MASSACHUSETTS.

ASHFIELD, MASS.—The Heath Telephone Co. at their annual meeting voted to extend the lines to Buckland and Ashfield and to sell $5,000 worth of stock, the increase bringing the capital stock up to $18,000. The directors are: W. E. Kinsman, of Heath; George E. Davis, of Shelburne Falls; F. L. Kendrick, of Colrain; Don Taylor, of Jacksonville, Vt. Herbert Newell has been chosen treasurer and George E. Davis clerk.

BOSTON, MASS.—Suburban Telephone Co., Suffolk county. Capital, $30,000; promoters, C. Francis Chisholm, A. N. Hooper, E. Lyman Brown, Austin A. Cushing, Nathaniel N. Spofford.

GREENFIELD, MASS.—The lines of the Heath Telephone Co. are being extended.

IPSWICH, MASS.—A new telephone service is to be added to the modern conveniences in Ipswich.

NORRIDGEWOCK, MASS.—Norridgewock & Fairfield Telephone Co., Norridgewock, capital stock $1,000, to transmit intelligence by telephone between the villages of Norridgewock and Fairfield, in Somerset county; pro-

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moters, J. D. Ames, E. H. Tobey, Frank L. Ames, Norridgewock.

MICHIGAN.

BATTLE CREEK, MICH.—The Calhoun County Telephone Co. has elected the following new officers: Charles F. Rood, of Grand Rapids, president; Lycurgus McCoy, Battle Creek, vice-president; E. B. Fisher, Grand Rapids, secretary; Alderman Frank Halladay, Battle Creek, treasurer; C. E. Tarte, Grand Rapids, manager. The company is virtually in control of Grand Rapids men. The company has increased its capital stock to $100,000.

BENTON HARBOR, MICH.—A big consolidation was brought about between the Twin City Telephone Co., of this place, and the South Haven system. The Twin City system, which is believed to have bought out the South Haven Co., will now have over 1,000 'phones on their line.

CARLETON, MICH.—The annual meeting of the People's Telephone Co., of Wayne, was held here. Joseph Waltz was elected president and Frank L. Edwards secretary and treasurer. The company was organized five years ago with a capital stock of $6,000, and at their meeting to-day were reported out of debt. The line is now connected with the Michigan Telephone Co. and is giving excellent service.

DETROIT, MICH.—The fifteen independent telephone companies of northern Indiana, Ohio and Southern Michigan will be consolidated under one general financial management, with headquarters with the Central Construction Co., at Wauseon, Ohio.

DIMONDALE, MICH.—The new switchboard of the Michigan Telephone Co. at Dimondale will shortly be installed, giving direct communication between that town and Lansing.

GRAND RAPIDS, MICH.—Grand Rapids claims to be the banner telephone city of the country. There are 7,500 'phones in active commission, a rate of one for every twelve inhabitants. Detroit's rate is one to twenty-eight and Chicago's is one to sixty-one.

GRAND RAPIDS, MICH.—George Stratemeyer, formerly employed by the Michigan Telephone Co., has been appointed manager of the Battle Creek telephone exchange, which has recently come into possession of the Citizens' Telephone Co., of this city.

HAVEN, MICH.—The purchase of the Oak Telephone plant by the Twin City Telephone Co., which has been talked of for some time, seems to be a fact.

HOUGHTON, MICH.—An intercommunicating telephone system has just been installed by the Houghton County Street Railway Co. for use between cars and stations. The innovation will be valuable in minimizing the delay in case of mishaps over the extensive car line.

KALAMAZOO, MICH.—The Michigan Telephone Co. has reduced the rate for residence telephones by one-half there, while the rest of the state will have to pay more hereafter than in the past.

LANSING, MICH.—The Rollins Telephone Co., Town House, $10,000 capital stock, has been incorporated.

MAPLE GROVE, MICH.—The Citizens' Telephone company has just completed a line between Nashville and Maple Grove.

MARSHALL, MICH.—The Calhoun County Telephone Co., of Marshall, has increased its capital stock from $100,000 to $150,000.

MENOMINEE, MICH.—A twenty-one year franchise has been granted by the city council to the Green Bay & Lake Michigan Telephone Co., owned by Former Gov. Schofield and A. L. Hutchinson. The line is to be extended from Escanaba to Milwaukee.

NORTH BRADLEY, MICH.—The Independent telephone line is completed from North Bradley to Midland.

ONONDAGA, MICH.—The telephone line from Aurelius to Onondaga is progressing finely.

PETOSKEY, MICH.—The Michigan Telephone Co. will furnish its Petoskey subscribers with a metallic circuit system.

SEBEWAING, MICH.—Workmen for the Valley Telephone Co. have been busy of late putting in new 'phones and making important changes in Sebewaing lines.

TECUMSEH, MICH.—J. B. Ware, of the People's Telephone Co., president of the Independent Telephone Association, of Michigan, was granted a telephone franchise by the common council of Tecumseh at its meeting. The construction must begin within eight months.

WAYNE, MICH.—The stockholders of the People's Telephone Co., of Wayne, Mich., held their annual meeting here and elected officers as follows: President, Joseph Waltz; secretary and treasurer, F. L. Edwards; board of directors, Jesse Butler, F. L. Edwards, Joseph Waltz, T. J. A. Miliken and W. S. Marey. The company is reported out of debt and doing a good business.

MINNESOTA.

BELLE PLAINE, MINN.—J. A. Schoell has been granted a franchise for a local exchange at Belle Plaine, Minn.

LANESBORO, MINN.—Work is progressing rapidly on the improvements to be made in Lanesboro by the Phœnix Telephone Co. Over $1,500 will be expended here. The rates for telephones will be $1.25 per month for business places and $1.00 for residences, or $2.00 for both business and residence 'phones on one line.

MINNEAPOLIS, MINN.—The Central South Side and East Side exchanges of the Twin City Telephone Co. will soon be installed, the permits having been already taken out. The Central exchange will cost $90,000; the South Side $25,000, and the East Side $15,000.

MILACA, MINN.—A telephone exchange will be established at Milaca by the Minnesota Rural Telephone Co.

MINNEAPOLIS, MINN.—Articles of incorporation of the Rapid Service Telegraph & Telephone Co., of Minneapolis, were filed

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with the secretary of state yesterday morning. The capital stock is $100,000.

NORTH BRANCH, MINN.—The Minnesota Co., of North Branch, Minn., has filed an amendment to its articles of incorporation increasing its capitalization to $50,000 and its limit of indebtedness to $20,000.

PRESTON, MINN.—The Rushford Telephone Co. has sold their lines to the Winona Co. for $15,000.

RED WING, MINN.—The Eureka Electric Co., of Chicago, has written to Red Wing, Minn, for information regarding the telephone service here. If the council will grant a franchise for an independent system, the company contemplates entering the field.

RUSHFORD, MINN.—The Winona Telephone Co. has completed the installation of new switchboards in the exchanges at Lanesboro and Rushford, Minn.

SHELL ROCK, MINN.—E. H. Eckles, of Tama county, has purchased the telephone line of the Cedar Valley Co., and will enlarge the system, taking in the surrounding towns.

VIRGINIA, MINN.—A new telephone company, known as the People's Telephone Co., with R. B. reedy as manager, has been organized and contemplates doing business on the range. Mr. Freedy, who was formerly manager of the Mesaba Telephone Co., has been soliciting contracts, and to date has met with phenomenal success, having secured nearly 200 contracts in Eveleth and Virginia.

VIRGINIA, MINN.—Quite extensive improvements are being made by the Mesaba Telephone Co. on their lines on the range. They have had a large construction crew at work on the line from Biwabik to Eveleth for the past two months, and have rebuilt that part of their system almost entirely. The entire plant is being rebuilt and the old line of poles from Eveleth to Virginia has been changed to a more direct route. New switchboards have been ordered for both Virginia and Eleveth, and the exchanges at both places will be rebuilt entirely before the first of the year.

MISSOURI.

BAY, MO.—Gasconade Central Telephone Co., of Bay: capital, $1,200; incorporated by E. T. Williams, W. F. Langenberg, Peter Danuser and others.

BUTLER, MO.—H. Reinhimer has purchased the telephone plant at Butler and Rich Hill, Mo., and will move there.

GALT, MO.—The Galt Telephone Co. increased its capital stock from $2,400 to $4,200.

KANSAS CITY, MO.—The Kansas City Home Co., of Kansas City; capital stock, $50,000. Incorporators, E. L. Barber, O. C. Snider, John Enoch and others.

MANHATTAN, MO.—The Manhattan Telephone Co., of Manhattan; capital, $2,400. Incorporators, Benjamin J. Backerville, Dennis Hogan and August Tennyson.

MONTICELLO, MO.—Citizens' Telephone Co., of North Missouri; $1,200. Incorporators, Cyrus C. Raine, Charles Little and others.

MOUNT STERLING, MO.—A new telephone line is being talked of from here to Mount Sterling. The stock is being subscribed by fafrmers along the line and by parties here.

RICHMOND, MO.—Frank Taggart has purchased one-half the Richmond Telephone exchange from Messrs. Green, Glasscock and Rust, and in the future the firm will be Taggart & Rust.

SHELBINA, MO.—The Kirby Telephone Co. is building a line from Kirby to Shelbina.

ST. CHARLES, MO.—The St. Charles Telephone Co. has recently organized. It proposes to put metallic circuits to every town in the county and give a service unexcelled.

ST. LOUIS, MO.—John Enoch, of St. Louis, Mo., has been granted a thirty year franchise to establish and maintain a telephone system in Kansas City. The grantee is bonded on $20,000 to begin work in sixty days. The ordinance provides for business telephones at $54 and residence telephones at $48 a year.

VANDALIA, MO.—A new telephone line is being built from Curryville to Bowling Green. This will give Vandalia connection with Curryville, Bowling Green, Farmer, Estes, and other points in Pike.

MISSISSIPPI.

BOONEVILLE, MISS.—The Booneville & Tupelo Telephone Co., Booneville; capital stock, $2,000. Incorporators, Philips, Hinds & Co., W. R. Whitesides & Co., B. A. P. Selman and others.

HATTIESBURG, MISS.—The telephone exchange which Mr. T. M. Ferguson established four years ago and sold to Messrs. Collins & Sons, has been sold to a stock company, which was recently organized, for $7,500. Mr. A. U. Montgomery is the president of this company.

HATTIESBURG, MISS.—People's Telephone Co., domicile in the city of Hattiesburg, county of Perry, with a capital stock of $30,000. The incorporators are A. U. Montgomery, T. E. Ross, W. A. Dozier and others. This is the first independent telephone company that has been chartered in Mississippi for several months, nearly all new construction work having been carried on by the Cumberland Co.

MCCOMB CITY, MISS.—The stock of the Pike County Telephone Co. has been purchased by the following well-known gentlemen: J. J. White, Dr. O. B. Quin, T. W. James and W. R. Caston. The deal was consummated to-day, and Dr. O. B. Quin was elected president, W. R. Caston vice-president and T. W. James secretary and treasurer, Messrs. J. W. Johnson, J. H. Stevens and W. M. White retiring. The lines will be extended and the service will be generally improved. The company now has exchanges in Summit, McComb City, Magnolia and Osyka and their lines reach as far north as Boguechitto, Miss., and as far south as Kentwood, La.

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NEBRASKA.

EAGLE, NEB.—The Eagle Telephone Co. organized permanently. The following officers were elected: President, A. C. Adams; vice-president, Frank Clements; secretary, S. A. Morrison; treasurer, G. W. Venner; board of directors, H. G. Wiggins, J. H. Lattom, William Sharp, James M. Beardsley, George Tumkenbolz, A. L. McDonald. The company starts out with about thirty stockholders. A local exchange will be built at once and the connecting line built out to meet the Palmyra line. Several other lines will be built in the spring.

LINCOLN, NEB.—A telephone line to extend from Lincoln to Garfield is being built.

WEST POINT, NEB.—The Nebraska Telephone Co. is building a telephone line between West Point and Bancroft, connecting the farm houses on the route with the system.

NEW YORK.

ALBANY, N. Y.—The Otsego County Telephone Toll Line Co. was incorporated to operate telephone lines in the towns and villages of Otsego county. The capital is $10,000, divided into $5,000 preferred and $5,000 common stock. The directors are: John Geer, L. Barker and John A. Losee, of Ritchneld Springs; F. C. Ward, of Delhi; William Rose and F Allen, of Schuyler's Lake, and J. W. Barnum, of Cherry Valley.

CASTLE CREEK, N. Y.—Castle Creek & Chenango Bridge Telephone Co., to operate in Broome county, connecting Castle Creek to Binghamton; capital, $300,000.

CLYDE, N. Y.—The Lyons Telephone Co. and the Wayne Telephone & Telegraph Co., including all rights, privileges and franchises, trunk lines and local exchanges owned and controlled by H. P. and S. E. Bishop, of Clyde, have been purchased by the Eastern Electrical Construction Co., of Philadelphia, Pa.

GRAND ISLE, N. Y.—A new telephone company has been organized in Grand Isle, to be called the Grand Isle Telephone Co. They have a capital of $2,000 and have a force of men already at work setting poles. Two tons of wire have been ordered and about twenty miles will be strung in Grand Isle and South Hero. It is expected that the line will be complete and many 'phones in by the first of December. The directors of the new company are Albert Kinney, Juan Robinson, Joseph Agle and Dr. F. W. Sears.

JAMESTOWN, N. Y.—A plant is being installed by the Home Telephone Co.

RICHFIELD SPRINGS, N. Y.—The Otsego County Telephone Toll Line Co.; capital, $10,000. Directors, John Geer, L. Barker and John A. Losee, of Richfield Springs.

RISINGVILLE, N. Y.—The following are the newly elected officers of the Campbell & Risingville Telephone Co. for the ensuing year: President, W. H. Rising; vice-president, C. J. Tomer; secretary and treasurer, Robert C. Turnball; superintendent of construction, E. J. Jerry; general manager, C. S. Smith.

SARATOGA, N. Y.—The Hudson River Telephone Co. has installed a new switchboard in the central office.

SYRACUSE, N. Y.—The directors elected at the annual meeting of the Columbia Long Distance Telephone Co. were J. J. Jermyn and John L. Wentz, of Scranton; George S. Wentz, of Drifton, and Ernest I. White, A. R. Peck, George H. Bond and R. J. Jermyn, of this city.

WASHINGTONVILLE, N. Y.—A telephone line is soon to be built from Washingtonville to Lincoindale by the Highland Telephone Co.

WALDEN, N. Y.—The Hudson River Telephone Co., of Newburg, will install a telephone system in Walden, N. Y.

NEW JERSEY.

BRIDGETOWN, N. J.—The Inter-State Telephone Co., which recently purchased the independent Home Telephone Co., at Bridgeton, will put in an entirely new plant there. New quarters have already been secured and leased for ten years.

CHERRYVILLE, N. J.—The Cherryville Telephone Co. has elected the following officers: President, Samuel K. Everitt; secretary, the Rev. A. E. Finn; treasurer, Andrew J. Pierson.

TRENTON, N. J.—The plant and franchise of the Home Telephone Company (independent), of Trenton, N. J., was sold by auction for the sum of $20,000.

OHIO.

CIRCLEVILLE, OHIO.—The Citizens' Telephone Co. has been compelled to enlarge its switchboard. A new section which recently arrived will soon be installed.

COOLVILLE, OHIO.—The Home Telephone Co., of Coolville, Athens county, was incorporated with $5,000 capital stock by H. H. Brown, Otto Booth, C. E. Barrows, W. C. Matlack and James Drain.

CINCINNATI, OHIO.—Charles Goodman has asked for a franchise to build a telephone plant in Lockland, near Cincinnati. The village council has informed him that if he will organize his company and let the other parties interested be known, they may grant a franchise.

COLUMBUS, OHIO.—To further complete the line of independent telephone companies in Northern Ohio the Newburg Telephone Co. has been incorporated at Columbus for the purpose of conducting a telephone business in Geauga, Lake, Ashtabula, Trumbull, Portage, Cuyahoga and Summit counties. The incorporators are George W. Stafford, of Newburg; C. H. Hubbell, W. D. Brewster, F. P. Shumacher, J. W. Hutchinson and Leon S. Hubbell, of Chagrin Falls. The capital stock is $10,000.

DEFIANCE, OHIO.—The Northwestern Telephone Co. increases its capital stock to $10,000.

FAIRVIEW, OHIO.—The Union Telephone

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Co., of Fairview, Guernsey county, has increased its capital stock from $10,000 to $25,000. O. V. Wells is president and E. P. Shipley secretary of the company.

FREMONT, OHIO.—The county commissioners granted to the Fremont Home Telephone Co. a franchise to erect poles and string wires west of Lindsev along the county road. The Home Co. desires to increase its rural 'phone service in that locality, and will do so at once, having secured the necessary permission.

JACKSON, OHIO.—The Jackson County Telephone Co. increased its capital stock from $50,000 to $75,000.

KENTON, OHIO.—The Kenton Construction Co. was organized here to build telephone exchanges. The first one of these will be at Orange, Tex. The company is capitalized at $50,000 and has unlimited resources.

MIDDLEFIELD, OHIO.—Middlefield now has thirty-two 'phones connected with the county service, and more will soon be put in.

NORTH RIDGEVILLE, OHIO. — The North Ridgeville Telephone Co., of Lorain county, increased its capital stock from $2,000 to $5,000. J. P. Riedinger is the president and C. P. Smith is its secretary.

TIFFIN, OHIO.—The Flat Rock Telephone Co., of Seneca county, Tiffin, Ohio; capital stock, $5,000. Incorporators, C. C. Pfund, T. E. Wygant, S. D. Huff, E. F. Leinhard, W. H. Gardner and F. E. Harris.

TOLEDO, OHIO.—State Senator Brorein and others have organized the Auglaise Construction Co. for the purpose of building and operating independent telephone lines through Ohio, Indiana and Illinois. It is said that work will be begun at once along some of the new interurban traction lines.

STEUBENVILLE, OHIO.—Extensive repairs are being made upon the telephone line between Steubenville and Richmond.

WAPUKONETA, OHIO.—Seven leading business men of this county and Charles N. Haskell, of Ottawa, have incorporated the Shaffer Construction Co., with a large capital, for the purpose of building and operating telephone plants in Texas. The company has already secured valuable franchises in Clevborn and Waxahachie, Texas, and A. E. Schaffer, manager, left to push the construction.

WELLSTON, OHIO.—The Wellston Mineral & Athens Telephone Co. has been incorporated with $2,000 capital stock to operate the independent line.

XENIA, OHIO.—The Xenia Citizens' Telephone Co. and the Clinton Telephone Co., of Wilmington, have completed a line between the two towns.

OKLAHOMA.

GUTHRIE, OKLA.—The Pioneer Telephone Co., with headquarters at Guthrie, Logan county, for a period of twenty years and with a capital stock of $500,000. The corporation will build and operate telephone lines throughout the United States, and the directors are John M. Noble, Bird S. McGuire and John N. Coulter, of Pawnee; E. E. Westervelt and David McKinstry, of Pery, and E. D. Nims, of Rolf, I. T.

HOBART, OKLA.—The Oklahoma & Southwestern Telephone Co., of Hobart; capital stock, $45,000. Incorporators, George Sturgeon, J. M. Chapman, Burford; J. M. Applegate, Hobart, and L. B. Thompson, of Kansas City, Mo.

WOODWARD, OKLA.—The Home Enterprise Telephone Co., of Woodward, for twenty years, and with $10,000 capital stock. The directors are C. R. Alexander, E. S. Wiggins, George H. Brophy, J. H. Hopkins, E. B. Roll, B. W. Key, F. D. Healey, L. B. Collins and Charles Swendall, all of Woodward.

OREGON.

BOHEMIA, ORE.—The Bohemia Telephone Co. has been incorporated to construct and operate a telephone line between Cottage Grove and Bohemia. The capital stock is $5,000. The incorporators are P. J. Jennings, W. F. Murphy and J. W. Cook.

ECHO, ORE.—The Butter Creek Telephone Co., of Echo, Umatilla county; capital stock, $500. Incorporators, A. B. Thomson, O. F. Thomson and J. B. Saylor.

PENNSYLVANIA.

CARLISLE, PA.—All of the old officers of the Southern Pennsylvania Telephone Co. have been re-elected. The company is considering a proposition to consolidate with several other companies which govern lines in Franklin and Dauphin counties.

DENORA, PA.—The Federal Telephone Co. has been granted the right to erect poles, string wires and operate a telephone service here. The ordinance provides that the rate of service shall not exceed $18 per year for residences and $24 for business houses. The company also agrees to furnish one 'phone free for the use of the borough.

ERIE, PA.—The work of constructing a telephone line to Le Boeuf has been begun.

HARRISBURG, PA.—The Adams County Telephone Co. has decided to merge the Hanover Telephone Co., the Cumberland Valley Telephone & Telegraph Co., of Franklin county; the Southern Telegraph Co., of Cumberland county, and the Dauphin Telephone Co., and form one new company to be known as the Cumberland Valley Telephone Co. B. F. Meyers, of Harrisburg, has been elected president.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Co. has just completed another exchange. Carnegie has been connected with the main exchange in Pittsburg, and a local exchange opened in the town of Carnegie with two operators in charge. The company has already in service fifty subscribers in Carnegie and is giving all-night service as well as a day service. Carnegie is connected with Pittsburg by four wires.

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WILKESBARRE, PA.—Seven independent telephone companies, including the People's, Lackawanna, Anthracite and the separate Allentown Telephone Co., will combine as the Central Pennsylvania Telephone Co., with E. Weyland as president.

TEXAS.

AUSTIN, TEX.—The Texas Telephone Co., of Witchita Falls, filed an amendment to its charter, increasing its capital stock to $6,000.

BELTON, TEX.—The Independent Telephone Co. is completing an exchange at Belton.

EDNA, TEX.—A telephone company is being organized by Mr. W. M. McCrary and others.

GALVESTON, TEX.—It is expected that the long-distance telephone line of the Citizens' Telephone Co., which is being constructed between Houston and Galveston, will soon be completed. This company has recently completed a line from Houston to Beaumont, which it is now operating.

MANSFIELD, TEX.—The Mansfield Co., of Mansfield, Tex., filed an amendment to its charter providing for extensions of its 'phone lines.

NACODOCHES, TEX.—The local telephone company, owned by Brandh & Sturdevant, have sold out all their interest to an Ohio capitalist, who will put the different lines in first-class condition with metallic wires and the latest improved 'phones. The transfer includes the city exchange, the lines to Shreveport, Beaumont, Jacksonville, San Augustine and Houston. Mr. J. L. Disener, the new company's manager, is now in charge of the office and has moved his family here from Wapakoneta, Ohio.

NACOGDOCHES, TEX.—The Texas Central Telephone Co., of Nacogdoches; capital stock, $10,000. Purpose: To construct a line of telephones through the counties of Nacogdoches, Rusk, Cherokee, San Augustine, Shelby, Jasper, Newton, Tyler, Liberty and Jefferson. Incorporators: E. C. Branch, W. S. Beeson and W. S. Patton, all of Nacogdoches.

SAN ANTONIA, TEX.—The Commercial Telephone Co., of San Antonia filed an amendment to its charter, extending its field of operations to thirty-three counties of the state.

TAYLOR, TEX.—The Williamson County Telephone Co., Taylor, Tex., to construct, acquire, maintain and operate telephone exchanges and toll lines at and between all points in Williamson county; capital stock, $100,000. Incorporators, James S. Brailey, H. M. Daugherty, W. H. Harper, Jr., J. E. Boynton and J. B. Earl.

WICHITA, TEX.—The Texas Telephone Co., of Wichita county, amended its charter by increasing the capital stock from $3,000, to $6,000.

TENNESSEE.

CHATTANOOGA, TENN.—A charter was granted to the City Telephone Co., of Chattanooga, with $50,000 capital stock. The incorporators are Sam Erwin, J. B. Whitehead, M. T. Freeman, J. W. Johnson and W. M. Lasley.

DIXIE, TENN.—The Dixie Telephone Co., of Grundy county, filed an amendment to its charter increasing its capital stock from $10,000 to $25,000.

MEMPHIS, TENN.—Telephone wires are required to go under ground at Memphis.

RICHLAND, TENN.—The Richland Telephone Co., of Grainger county, capitalized at $1,000, and incorporated by William Stone, Sam McBee, A. E. Foster, W. A. Frazier and Sam McKinney.

SCOTSBORO, TENN.—W. L. Moody is rapidly pushing the work on the new telephone line between here and Stephenson. Mr. Moody expects to have the line in operation in about four weeks.

WASHINGTON.

SEATTLE, WASH.—S. B. Claypool, manager of the independent Telephone Co., has sent a request to City Comptroller Paul asking that the $3,500 deposited with the city be returned. He cites that the conditions of the franchise have been carried out. Comptroller Paul will refer the communication to the city council.

TACOMA, WASH.—Oriental advices received by the steamer Victoria, which arrived at Tacoma, Wash, say that Baron Masahide, of Tokio, has obtained from Director Sheng, of the Chinese railways, a concession for the erection of telephone lines which will connect the largest cities throughout China. The preliminary arrangements contemplate that China shall furnish the funds and the Japanese the experts and material. The Japanese naval department is preparing to establish a steel plate factory at Kure at a cost of 6,000,000 yen (about $3,000,000). The plant will be in working order in three years.

WISCONSIN.

ASHLAND, WIS.—Mr. Byrant has secured a franchise for the Lake Superior Telephone Co. This company has a capital of $500,000.

DODGEVILLE, WIS.—Dr. W G. Ruggles, of Hyde, has commenced the construction of a telephone line which will connect Ridgeway Arena and Dodgeville, and possibly Spring Green. The line is new throughout. There have already been constructed three miles of the line and poles strung for some considerable more of the distance.

ELKHORN, WIS.—The Wisconsin Telephone Co.'s line from Elkhorn to Heart Prairie is being rebuilt, and will be a full metallic circuit, instead of a ground circuit, as heretofore.

FOND DU LAC, WIS.—The much-rumored consolidation of all the independent telephone companies in Wisconsin will probably be effected early in the spring. This information is given out by one of the directors and principal stockholders of the Little Wolf River Telephone Co., which has its main office in this city. Previous efforts to get a state-

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ment from any of the local stockholders of the company have been without avail.

KENOSHA, WIS.—The Wisconsin Telephone Co. reports a net gain of 382 subscribers in October and a net gain of 2,418 subscribers since Jan. 1, making a total number of 23,196 subscribers on Oct. 31. The Erie Telephone system, of which the company is part, reports a net gain of 2,369 subscribers in October, and a net gain of 15,968 since Jan. 1, making a total number of 158,338 subscrubers on Oct. 31.

LA FARGE, WIS.—Mr. Harris sold out his interest in the telephone business to Mr. Tom Brockley.

MADISON, WIS.—The Antigo Telephone Co. filed articles of incorporation with the secretary of state. The capital is $25,000 and the incorporators are M. Spencer Koebke, J. C. Spencer and Richard Koehke.

MADISON, WIS.—The Farmers' Telephone Supply Co of Milwaukee, filed an amendment to its articles decreasing its capital stock from $500,000 to $50,000.

MILWAUKEE, WIS.—The Great Western Telephone Co. has been incorporated with a capital stock of $500,000. The incorporators are C. G. Forster, E. R. Stillman and C. W. Millbrath. The company proposes to build, own and operate telephone and telegraph lines in this city, the state and the entire country.

MILWAUKEE, WIS.—Articles of incorporation have been issued to the Milwaukee (Wis.) Telephone & Telegraph Co., with a capital stock of $25,000. The members of the company are F. C. Winkler, Edwin Reynolds and E. A. Wadhams.

MILWAUKEE, WIS.—John D. McLeod, the general manager of the Wisconsin Telephone Co., has returned from East Troy, where he made a thorough insnection of the country telephone system, installed there. Mr. McLeod is greatly pleased with the system, and declares that the farmers of the vicinity consider the introduction of the telephone as a great improvement. The lines, while not under the management of the Wisconsin Telephone Co., connects with its exchange, and thus give the farmers and outside connection.

RHINELANDER, WIS.—The capital stock of the Oneida & Vilas County Telephone Co. has been increased to $10,000 for the purpose of building a toll line from this city to Merrill, giving connections with all the Wisconsin valley towns.

OTHER STATES.

SCOTTSBORO, ALA.—The citizens of Paint Rock valley are building a co-operative telephone line up the valley from Paint Rock Station, which will be of great value to them, as they are cut off from outside communication for several miles.

COLORADO SPRINGS, COL.—William C. Robinson will ask the city council for a franchise to install a new telephone system in Colorado Springs. Mr. Robinson proposes to cut the present telephone rates almost in half, if he is granted a franchise, and promises to begin the work of constructing the system within six months.

WILMINGTON, DEL.—Thomas McCorkle, president of the Delmarvia Telephone Co., is much pleased with the success of the new extension of the lines of that company to Newark, and he is determined to give the people there as good telephone service as can be found in the country. Mr. McCorkle takes a personal interest in the affairs of the company and his aim is to always look after the comfort and accommodation of the subscribers.

LAS VEGAS, N. M.—The Las Vegas Telephone Co. filed a $5,000 deed of trust in favor of the First National bank. This is a movement of progress and by no means one of embarrassment. It simply liquidates a small floating debt, the money to go toward large improvements which are to be made.

MCINDOES, VT.—The Citizens' Telephone Co.'s lines have reached McIndoes and they are busy putting instruments in that and intermediate villages.

WHEELING, W. VA.—There was left for record in the county court a deed of trust from the National Telephone Co. to L. J. Bayha, cashier of the German bank, for $50,000. It is to secure a bond issue of that amount, which is to provide for the completion and extension of its system.

FOREIGN.

ENGLAND.

LONDON, ENG.—The new telephone line between Brussels and London will be 288 miles long, of which 65 miles will be under the sea. The busiest telephone line involving cable transit so far is that between Paris and London, 261 miles. It costs $2.00 for a three-minute talk. The only other important sea telephone is that which runs from Buenos Ayres to Montevideo, a distance of 217 miles.

LONDON, ENG.—In London dissatisfaction with the National Telephone Co. has resulted in arrangements for the assumption, by the postoffice authorities, of the telephone business of the city. This experiment in governmental control may prove successful and it may not, but it is one of the logical results of a wretched service and high charges. It will prove highly expensive to the National Telephone Co. in any event, and will teach other public service corporations what to expect if they do not serve the public as they should. In that way it may prove to be of greater value than as an experiment in public ownership.

MANCHESTER, ENG.—The draft scheme has been published for the establishment of a joint board under the proposal to set up a municipal telephone service in the Manchester telephone area. The area within which it is proposed to establish telephonic communication is as follows: The city of Manchester, the

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county boroughs of Salford and Stockport, the borough of Eccles, and the urban districts of Alderley Edge, Altrincham, Audenshaw, Ashton-upon-Mersey, Bowdon Cheadle and Gatley, Denton, Droylsden, Failsworth, Gorton, Heaton Norris, Knutsford, Levenshulme, Moss Side, Prestwich, Reddish, Swinton and Pendlebury, Sale, Stratford, Urmston, Whitefield, Worsley, Withington, and Wilmslow. The scheme was submitted to the city council on Wednesday. It is intended, under the bill to be introduced into Parliament, to ask that the postmaster-general may be empowered to grant to the joint board a license authorizing them to provide a system of public telephonic communication within the area or within such smaller area within those limits as may be defined in the intended act or license, and to authorize the board to accept such license and to exercise and do all such acts and things as may be necessary or proper for carrying the license into effect, and to empower the postmaster-general to extend, alter, or amend any license or to grant new or additional licenses. Powers to carry the telephone wires through the necessary streets and highways are also to be asked, subject to restrictions with regard to overhead wires and other matters.

MANCHESTER, ENG.—Belgium and the Netherlands are to have telephonic communication with London and other large cities of England, according to a report to the state department from United States Consul Roosevelt, dated at Brussels, October 10. Consul Roosevelt says that very soon a new submarine telephonic cable will be laid connecting Brussels with London and that the circuit will be so disposed as to serve, besides London and Brussels, Antwerp, Liege, Birmingham, Manchester and Liverpool. Mr. Roosevelt says that the point of immersion on the Belgium side will be near La Panne, and that the line will emerge again at Ramsgate, on the English coast.

HUNGARIA.

BUDAPEST, HUNGARIA.—The new Hungarian system of telegraphy is a success. The system has been installed between Budapest and Fiume, a distance of 375 miles, and is in practical working order at a speed of 40,000 words an hour. Messages are written in Roman characters and require no transcription. As a system it is an ingenious combination of the telegraph, the telephone and photography, the messages being written on sensitized paper by ray light and developed and fixed by an automatic process.

A DETECTIVE TELEPHONE.

Many of the hotels in the larger cities are now being equipped with telephones in each room. The telephone in the room of a swindler in Philadelphia led to his detection and arrest. A man who had been a guest of a New York hotel for some time and finally left, accompanied by a large number of diamonds and other jewelry, as well as a considerable quantity of money which had belonged to his fellow-guests, went to Philadelphia, and, taking a room, remained in hiding there, giving illness as an excuse for having his meals brought to him and to account for his never leaving his room. The New York hotel proprietor had called up the proprietors of several Philadelphia hotels and described the man he wanted. The proprietor of the hotel where the thief and swindler was in hiding said he had a suspicion that his mysterious guest was the man wanted, but that it would be impossible for anybody to see the man, as he kept his room zealously and no one but the chambermaid or a waiter carrying in the meals was permitted to enter. The New York hotel man arranged with the Philadelphia landlord to have the chambermaid go into the swindler's room and take down his telephone and talk with the New York man, who was in his own hotel, 150 miles away. The maid carried on a conversation as though she were talking to one of her friends in the next block or two.

In the midst of her conversation, when the man in New York was listening intently, the maid held the receiver of the telephone carelessly in her hand so that it pointed squarely at the bed, and asked the swindler if her conversation annoyed him. He answered at once that it did not annoy him in the least and that she might go ahead and talk all she pleased. The man's voice was plainly heard by the hotel man in New York, who recognized it at once, and soon an officer armed with the proper papers was on his way to Philadelphia, and that night the swindler was taken into custody and the next day was escorted back to New York, still reviling the telephone which had been the means of his undoing.

TO SOFTEN STEEL.

Heat steel to a low cherry red, and when cooled so it is black in a dark place cool in the juice or water of common beans.—Shop Talk.

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TALKS AND CROSS-TALKS.

BY THE INSPECTOR.

HINTS TO CORRESPONDENTS.

Write on one side of the paper only, and make sketch or diagram, when necessary. Endeavor to give all the facts bearing on the case, so as to enable the editor to answer intelligently.

Name and address must accompany each letter, not for publication, but for the information of the publisher.

165. MR. INSPECTOR,—I would like an answer to the following questions:

(A) First, are the galvanized wire sleeves (same style as the McIntyre) a satisfactory and efficient method of splicing No. 12 iron or steel wire for toll lines, etc.? And would they be as good as a twisted and soldered joint, strength and all considered?

(B) Second; We have a toll line with ten offices. Wire No. 12 Washburn and Moen soft steel. Joints all soldered, except a few splices which were made with a three-wire joint (1. 3. an extra piece of wire twisted in when the two ends were right together). 'Phones are connected to lines with No. 14 and 16 insulated copper wire. 'Phones are bridging bell 1600 ohm bells. Stromberg-Carlson four-bar generators. Most of the time No. 4, 5, 6 and 8, also 3 (see Fig. 1), cannot ring to exchange and exchange cannot ring No. 5 or 6. Both have to call No. 7 and have them ring the other. What is the probable cause of this trouble and the remedy?

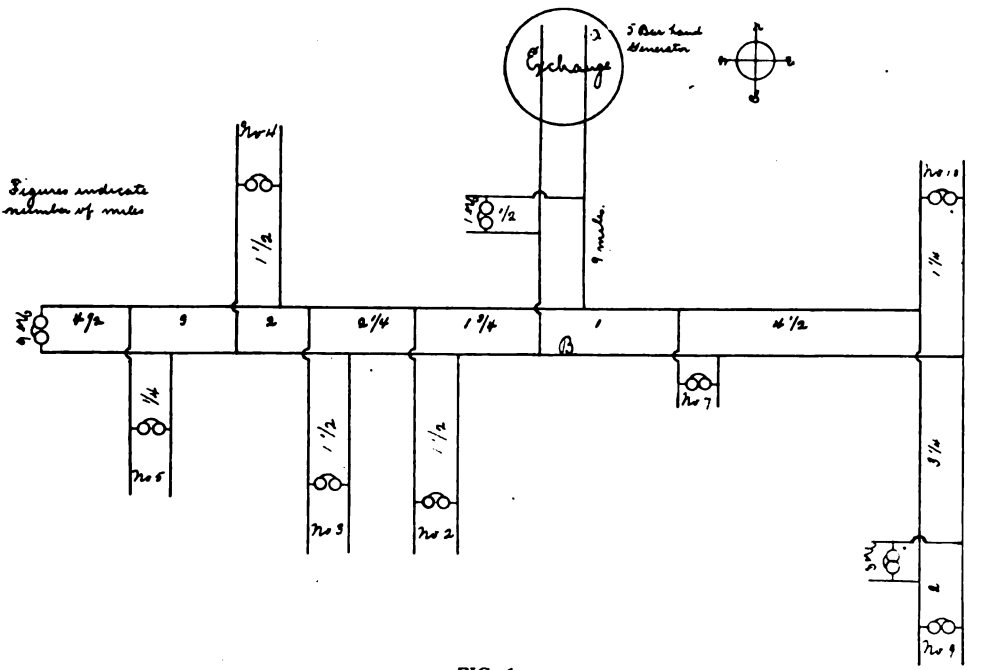

FIG. 1.

(C) Third, if we run another circuit from A to B and take off 1, 7, 8, 9 and 10 from the present arrangement (see Fig. 1) and put them on the new circuit,

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could all stations probably ring in to exchange?

(D) Fourth, is the socalled three-wire joint any better than a plain twisted splice, except in point of strength, or is it as good as a plain twisted and soldered joint?

Hoping to see answers to my questions in a future number of THE TELEPHONE MAGAZINE, I remain yours truly, etc.,

W. S. P.

(A) To my mind, the joint you speak of is far more satisfactory than a plain twisted joint, and on a test shows less resistance, weight considered, than a twisted and soldered joint. They naturally possess more strength than a regular Western Union joint, from the fact that the twisted reduces the tensile strength of the wire, although there are some who claim otherwise. A good soldered joint may always be depended upon.

(B) The cause of your trouble is that the permanent magnetism in both the fields of the ringer and generator is not as strong as it should be. They should be magnetized again. In last month's MAGAZINE you may see how this may readily be done.

(C) Of course I would always advise for a circuit to have an underload better than an overload. Of course this would help you, and undoubtedly the 'phones would work. But I would first try the method I spoke of in answer to question (B), this being cheaper.

(D) Question (A) and question (D) are very similar and are both answered in the answer to question (A).

166. DEAR SIR,—(A) We have several grounded party lines of different lengths. Two of these lines are each about four miles long, with several spurs on each. Some time ago the earth induction on the south line took a curious streak; the noise in the receiver could be described as a rattling sound, a good deal like that of a loose insulator rattling on a line that vbrates strongly; this noise is altogether different from regular "frying and sizzling." The noise became so troublesome that the line could hardly be used, but in a day or two it left this line and has never bothered on that line since. A day or two later the same trouble appeared on the line running north; it would bother for a day or two and then pass away. It has reoccurred on this north line several times, the other lines at this time being almost quiet. Can you suggest the cause and a remedy?

(B) We have two grounded party lines and one metallic line running south on the same poles, the grounded line being on each side of the metallic line, the metallic line being transposed at short distances. The cross-talk on the two-party line is very bad. Can you give a remedy? Would transposing the grounded lines with each other help the matter?

(C) Would it be better to ground each line separate? Our lines are all grounded at one place—at the central.

(D) Should the common return wires from different directions be run separately, right to the switchboard, or is it as well to unite them at the pole? Is it well to ground the common return? If not grounded is there not more danger from lightning to the instruments and switchboard? If the common return wires should be run separately to the switchboard and should be grounded how would this be done without connecting them through the ground? Yours very truly.

S. J. P.
Per E. Mc.

(A) This is a case of trouble which results evidently from a loose connection along the line, and could be remedied by all connections being soldered. The reason it stops and then starts again is the wind blowing strong tightens it up, and the constant swaying of the line loosens it again. You would find that if you would tighten up the slack spaces in the line this might easily be remedied.

(B) I would recommend that the whole

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lot be transposed, and if this did not relieve it I would connect in a repeating coil on each one of the party lines, although about four transpositions to the mile should remedy this.

(C) I do not understand what you mean by grounding each line separate, unless you mean that you run the ground side of each subscriber to the ground. This is unnecessary work, and that you will find by using a heavy size wire and connect them all together and ground this heavy wire to a good, substantial ground; you will have much better results.

(D) It is not necessary to run the common return wires separately to the switchboard, providing you use a heavier size wire for your common return. One

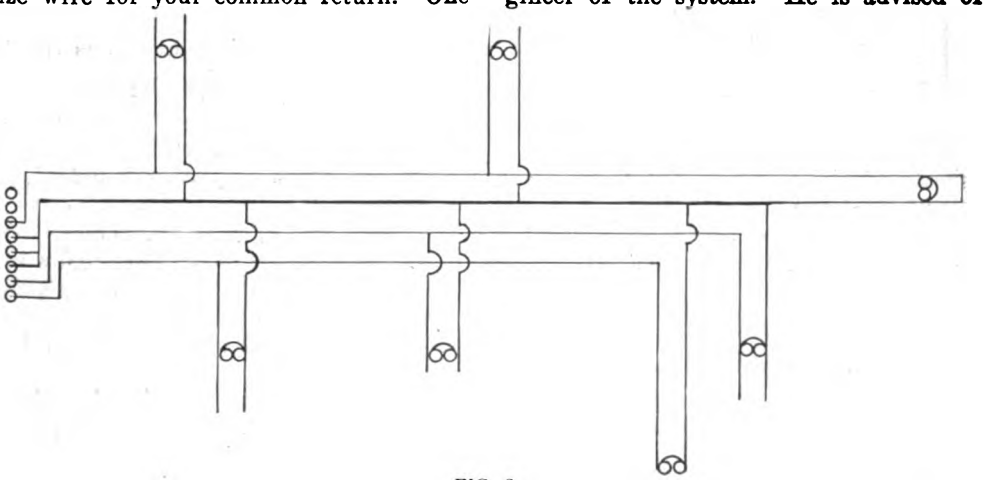

FIG. 2.

good, heavy common return wire, not smaller than No. 10 B and S, with all common return leads soldered to it, makes a very good system. The common return should not be grounded. In your question you have just reversed things. There is very little danger from lightning with a common return that is not grounded. While, with a common return that is grounded, you make a better path for a high tension current, so by all means do not ground the common return. I do not understand what you mean by the last sentence in the last line. I would very much like you to make this question clear to me in another letter.

167. DEAR SIR,—Will you kindly answer the following questions?

(A) What are the duties of a wire chief in an exchange of about 7,000 subscribers?

(B) What is the name of a concern in Grand Rapids, Mich, that sells bule prints of telephone circuits. Yours very truly,

A. H. S.

(A) The wire chief's duties are different in some exchanges than others. He sometimes has charge of the cable and line testing, also the testing of instruments ar in his charge; in a medium size exchange he attends to the testing himself (such as you speak of), also is in charge of the maintenance department. Sometimes he is required to be the engineer of the system. He is advised of all contract work, and is looked upon to improve and keep up the efficiency of the service. In position he ranks third in the actual work of the exchange; that is, manager, engineer, wire chief.

(B) Your other question was answered by mail.

168. DEAR SIR,—Referring to the Talks and Cross Talks of your magazine, I take the liberty to write you to know if there is any coil made that can be cut in series with a line wire that I can ring and talk through, but which will not permit a direct battery current to pass. If so, how are they made? How is a condenser made that would work satisfactory for the purpose. A SUBSCRIBER.

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(A) An ordinary repeating coil will answer the purpose, or any coil having about 250 ohms on the primary and 350 ohms on the secondary. But of course your battery current flowing over a line of this description would be used up. But for this purpose I would recommend a condenser, as the line is then practically open for a direct current, but closed for an alternating current.

(B) A condenser is made of alternate

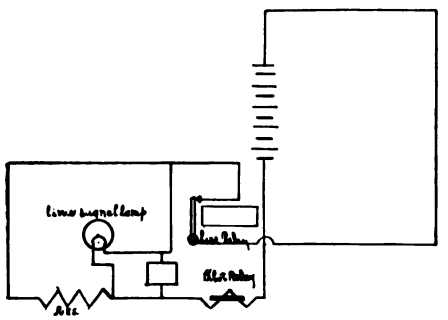

FIG. 3.

sheets of tin foil and pariffined paper, about 12 sheets for each side. You will find an elaborate condenser article in the May, 1901, number of THE MAGAZINE.

169. DEAR SIR,—How and why do carbons for telephone batteries lose their power and how can they be restored? I have reference to the carbons that are made up of a straight piece of carbon, surrounded by carbon chips, enclosed in a sack.

(B) When one telephone is connected with another, would not the battery of one work in opposition to the battery of the other if the zinc of one battery was connected with the positive side of the line and the zinc of the other battery connected to the negative side of the line?

Yours, A. S. F.

(A) This is caused by the liberation or freeing of the ammonium, which enters the pores of the carbon particles, this being a non-conductor increases the resistance, which causes the falling off of the E. M. F of the cell. These may be restored to life by boiling them in water and rinsing them good; this washes out the ammonia from the carbon magnese. After they are dry you will find them as good as new.

(B) This is not the case where there is an induction coil used on the telephone, as the battery does not get out on the line, so this does not make any difference; so, consequently, this does not make any difference.

170. DEAR SIR,—Could I change a series bell of 100 ohms to a bridging bell of 1000 ohms by inserting a resistance of 450 ohms of some kind on each side of the ringers? Would that work?

(B) Would figure 2 give satisfactory results on country line three or four miles long?

Kindly answer these questions in THE TELEPHONE MAGAZINE, and oblige.

Yours, J. H. P.

(A) It would work as far as the ringers were concerned, to a certain extent, but this resistance being non-inductive, a generator would not be able to do as much work as on a line where the ringers were all wound to 1600 ohms. Your generators of your series bell would not ring the bells on a bridging line; so you could not change the 'phones.

(B) I see no reason why this should not work. In fact, it is not a bad plan.

A PUZZLE.

171. DEAR SIR,—Who will solve the problem:

We have four grounded telephone lines, two lines on the same poles for three miles, other lines for shorter distances.

One telephone, three extension bells, all 1600 ohm ringers; four D. P. D. T. knife switches and one ground wire, in moist earth, comprise our apparatus at central office.

We have no trouble from cross talks, cannot hear conversation from one line to another, have good service on all lines, yet when we ring one bell all four will ring. Other stations signalling us ring

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but one bell. Our method of wiring—line is attached to lever of each switch block, bell to right hand points of each block, and 'phone to left hand points of all four blocks, which are connected only at left hand points. W. H. G.

This is one that I am going to let my readers guess at, and for the best answer, with a diagram showing cause of the trouble and the best way to remedy it, the editor has kindly allowed me to make a present of a two-years' subscription to THE TELEPHONE MAGAZINE. Answers will be received up to January 15th. The different answers and the winner's name will appear in the February number.

172. THE INSPECTOR. DEAR SIR,—I enclose a few questions that I would like you to answer.

(A) Figure 3 is of the signal circuit that I believe is used in some if not all of the Bell common battery exchanges. T represents one coil of the toll counter. Is the resistance coil used merely to enable enough current to flow to operate the pilot relay, or is it to protect the line lamp in some way? Why is it used if not for either of the above two reasons?

(B) Can you tell me what is the approximate resistance (cold or hot) and the candle powers of the line lamp signal? The pilot lamp signal and supervisory lamp signal used in the same exchanges referred to above?

(C) I would also like to know the resistance of the line relay, cut-off relay and relay No. 25 in cord circuit controlling the supervisory signals.

I enjoy your magazine very much. Thanking you in advance, I beg to remain, H. S. S.

(A) The resistance is used merely as a balance to maintain the system.

(B) The resistance of the lamp varies with the voltage; approximately the resistance of most lamps used in the exchanges vary from five to forty ohms, and, when illuminated, one-half of this. Relays are built in variable resistances. If you would send me the dimensions of the coil and size of the wire I could figure approximately the resistance.

(C) This question I could not answer, unless you would do as directed in the above answer.

173. THE INSPECTOR. DEAR SIR,—Will you please send me directions to make a storage battery. I want to make a small one, the plates to be seven in number; size, 4x4½, and some large ones, and oblige. Yours very truly, H. E. B.

(A) You will find all the directions you need in the excellent articles, the "Educational Course," now running in THE TELEPHONE MAGAZINE. Or, if you would address the author of these articles, he would undoubtedly furnish you with complete information.

175. DEAR SIR,—(A) Will you please form me what the result would be under the following conditions:

(A) Take an ordinary two-pole,

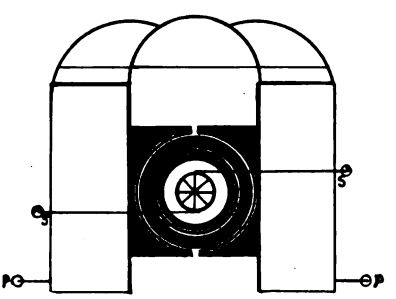

FIG. 4.

straight current dynamo and use same as transformer-fields as primary armature as secondary; now put primary on to an alternative of suitable voltage, and we will receive an alternating current out of bushes with armature standing still. See figure 4.

What I desire to know is if we revolve armature at high rate of speed, what will be the result?

Will the amount of energy in secondary be greater? Will the voltage be greater. Will not the number of alternations remain the same? Do not con-

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sider the loss of energy expended in revolving armature.

Trusting that I have made plain my question, I remain yours truly.

C. L. G.

(A) Your induced effect would be very slight, from the fact that there being a great deal of space between your primary and secondary. If you would drive your armature up to a high rate of speed you could figure up to 20,000 revolutions per minute. You would increase your alternations one for each revolution. The induced effect would diminish in proportion to the increase in alternations.

175. Dear Sir:—(A) Will you please tell me the remedy for my trouble. I have a series 'phone, Holtzer-Cabot generator, which will not receive a ring from central, neither will t ring its own bells when the crank is turned rapid. But receives and gives all O K when the crank is turned slow.

(B) I also have trouble on two of my drops on the Eureka board grounded line when I ring through them; the crank pulls hand and throws the drop enough so that when the plug is pulled out it falls. It gives a good ring through it. Please answer and oblige. Yours very truly. C. T. E.

(A) You do not define your trouble clear enough, but would judge that the trouble is caused by loss of permanent magnetism in the field piece. In letter No. — you will find how to remedy this trouble.

(B) These two coils are evidently grounded through high resistance. I would take them apart and wipe off all the pieces. It might be that in soldering the drop in the factory there may have been a line of corrosion started while soldering the coil. This should remedy your trouble.

176. INSPECTOR. DEAR SIR,—Can you explain cause of the following trouble?

(A) We have a 25 pr. rubber cable 750 feet long and have about 15 pr. in use. We run common return from cable box to the subscribers and metallic to office, and 10 pr. is on separate return from the other 5. The cross talk on the 10 pr. is so that two cannot talk at the same time. Will you kindly suggest some way that will help us out of this trouble? Yours truly, H. A. B.

(A) Either your connections on your common return are not soldered or your common return is not large enough. I recommend that no size under No. 10 wire be used for common return. You will find that by increasing the size of your common return you will overcome this trouble.

UNCLE SAM'S RUST REMOVERS.

The rust removers prescribed by the United States artillery directions are as follows:

"Cyanide of potash is most excellent for removing rust and should be made much use of. Instruments of polished steel may be cleaned as follows: First, soak, if possible, in a solution of cyanide of potassium in the proportion of one ounce of cyanide to four ounces of water. Allow this to act until all loose rust is removed, and then polish with cyanide soap. The cyanide soap referred to is made at follows: Potassium cyanide, precipitated chalk, white castile soap. Make a saturated solution of the cyanide and add chalk sufficient to make a creamy paste. Add the soap, cut in fine shavings, and thoroughly incorporate in a mortar. When the mixture is stiff cease to add soap. It may be well to state that potassium cyanide is a violent poison.

"For removing rust from iron the following is given: Iron may be quickly and easily cleaned by dipping in or washing with nitric acid one part, muriatic acid one part and water twelve parts. After using wash with clean water."—Shop Talk.

TO HARDEN SMALL TOOLS.

To harden small tools or articles that are likely to warp in hardening, heat very carefully, and insert in a raw potato, then draw the temper as usual. A bar of hard soap is also good, but will not make the tool as hard as the potato will.—Shop Talk.

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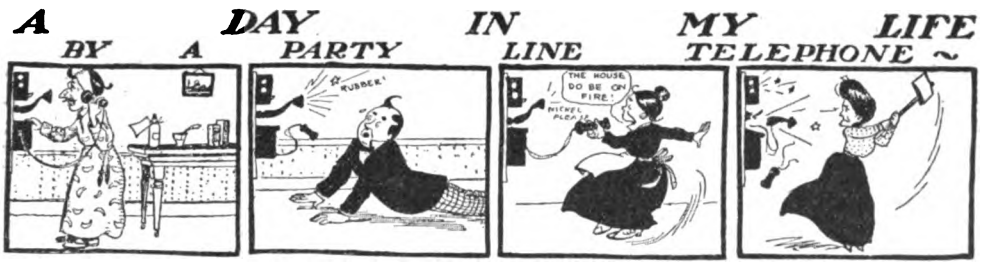

I am a party line telephone.

I do not like my job.

My, my, what a terrible time I have, to be sure. I don't suppose there is anything in this great, wide world any busier than I am. There's ten or fifteen at least of us telephones, all on this one wire, and for all I know there's twenty-five or thirty. This is the baby-blue circuit we're on. There are other circuits—mauve, old gold, orange, and what not. All the circuits are named after some color. The only color really appropriate for us to be named is yellow, but none of the circuits have been called that yet.

I am the busiest little bee that ever was. While I do not gather honey every hour I do gather in a nice store of nickels, and I am always out for more. I fairly yawn for nickels, and if I can I swallow them quietly so that they make no noise in going down, and then the telephone operator makes the individual who is talking pay another nickel or retire to a rear seat.

Of course I have to stand a good deal. My head is buzzing all the time from all the talking which passes along the wire right through me. Then the people who converse with my kind assistance do not seem to like me. They abuse me outrageously. They shake their fists at me and swear worse than our army is said to have done during the rainy season in the Philippines. They take the receiver and jam it down on my side as though they were trying to break me in two. They slap me over the head and make faces at me and call me everything, from a cheat and a swindle to a cuneifex thogamadalion.

But in my quiet way I manage to get even. I refuse often times to give them the proper signals, and I always arrange it so that whatever signal I give everybody along the line will recognize it as their own, and they will all leap over chairs and sofas in their mad rush to reach all the telephones on the circuit.

My station is in a boarding-house in Dearborn avenue. Early this morning my duties for the day commenced. A young man who rooms in the house wanted to call down to the store to say that he could not work that day owing to his illness. Just after he made the connection and was commencing to explain in a doleful voice how bad he felt, I slipped a cog, and before he knew it he was telling all his troubles to a grocery man who did not seem in the least interested.

Then I purposely sounded my signal wrongly several times and created a good deal of consternation in the house, as it seems that there were three or four of the boarders who were waiting to be called up. I kept them all jumping hurdles and hustling lively for awhile, but finally they despaired and had to content themselves with addressing me in suppressed but none the less acrimonious language.

Mrs. De Warr came out finally and commenced to call Black and Tan 7766. Some sweet young thing at the other end of the circuit was talking at the time to another sweet young thing on the Crushed Strawberry circuit. When Mrs. De Warr called for Black and Tan 7766 I heard the first sweet thing say:

"O, isn't it nice to have some old thing climb right in front of you every time you try to talk. Well, she won't this time. I wanted this wire before she did, and I beat her to it, and she might as well go back to the pantry."

Then the other sweet young thing

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said "O, that is what it is. I thought it was some stray cat that had crawled into the telephone some way and was yowling. I guess that will hold somebody for awhile."

Mrs. De Warr grew angry at this. She started to say things, but the girl over at Central sternly bade her, "Put a nickel in the slot."

To my certain knowledge Mrs. De Warr had already put one nickel in the slot, but I needed the money and so I said nothing while Mrs. De Warr, after considerable declaiming, placed another nickel in my omnivorous maw. I swallowed that easy like and softly, too, so that Central commenced shrieking like a Kansas cyclone for another nickel, and Mrs. De Warr was so angry that I really feared she would attempt violence.

About this time the house caught afire somewhere back in the kitchen and I saw my opportunity. I buzzed and clicked and did all sorts of things and ate nickles as fast as they would pour them in, but flatly declined to do business. When the cook finally got hold of the wire and began to talk I was truly delighted to find that she was holding converse with the butcher down the street.

"O hurry up, hurry up," gasped the cook, "the house do be on fire."

"Vat," said the butcher. "Vat its it you vant on der fire, a nice boil or a roast, hey?"

"O, the house is burning," screamed the cook.

"Put a nickel in the slot, please," said Central sharply.

"I can't put a nickel in," said the excited cook, "sure my money is in the kitchen, and the kitchen is burning up."

"Put a nickel in the slot, please," said Central.

But by this time some boarder had put his head out of the window, and after yelling like a Comanche for awhile attracted the attention of a policeman across the street, who soon sent in an alarm over the police wire.

After the excitement of the fire there was nothing doing for awhile, and I began to yearn for nickels. I chirruped a few times, and finally lured an unsuspecting old lady over who took down the receiver and started to say hello when Central fiercely demanded: "Nickel, please," just like a footpad saying, "Hands up." The old lady was so frightened that she shoved in a dime in her wild alarm, and then tried to put three postage stamps and a dollar bill down the slot.

"What do you want?" demanded Central. "Hurry up. What number do you want?"

"I don't want any number," shouted the old lady in a "don't shoot" tone of voice.

"All right then," said Central, with fine scorn. "Good night."

"Good night," said the old lady, and she retreated, scared half into convulsions, I am certain.

I had another rest and then Mrs. Dibbins rushed up and grabbed down the receiver to telephone that the baby had just swallowed his savings bank, and for the doctor to come with a stomach pump.

She cut in on a man who was asking a girl why she treated him so coldly at the party the night before.

"Well, you know what Clarence told me," said the dear girl.

"No, I don't," said the man. "What is the matter with Clarence?"

"O, he's swallowed his bank, he's swallowed his bank," wailed Mrs. Dibbins.

"That's what I thought," said the man. "I never saw him spend anything. When he gives a girl a frolic he reads to her out of the magazines."

"Now, you needn't say anything about Clarence! That wasn't me that said he had swallowed his bank. It was one of those old Cutinskys at the boarding-house."

"Which one?" asked the man, "Clarice or Gladys?"

"This is Carrie Dibbins," shouted the mother of the child that had just eaten a bank. "Carrie Dibbins and I——"

"O, is that Carrie?" asked a voice over the wire. "Good morning, Carrie. How do you do this morning? Did you——"

The exasperated parent grabbed the

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receiver and yanked it right out by the roots and then hit me right over my heart, where I keep the nickels I swallow. She pounded the receiver all into small bits and then she started to carry the baby down to the doctor's and then discovered the bank lying in the bottom of the crib.

But it's all up with me until the lineman comes over and fixes me up. I hope he will hurry, for I am missing a lot of fun.—Chicago Tribune.

TRADE NOTES.

The Electric Appliance Company, Chicago, are advertising their special five-magnet generator type, No. 36 telephone, for heavily loaded or poorly constructed farmers' lines. They claim that they will ring through anything.

The Smith & Hemenway Company and the Utica Drop Forge & Tool Company, 296 Broadway, N. Y., are offering as their latest novelties in plyers a side-cutting, long-nose plyer. The advantages claimed for this plyer is that, having a long, narrow nose, it will be of use in deep, narrow quarters in which an ordinary tool will not work, and also will do the work of a regular tool. It is convenient to carry. Every tool is carefully tested at the factory before sending out. Can be used by telephone manufacturers, machinists, engineers, electricians and jewelers.

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"But I have no time," said the bandmaster. "The ship sails this evening. There is just time for a violinist to be hurried down here from London, but no time for me to go up to the city to hear them play."

"Well, I'll tell you what, old chap," answered the clerk at the agency. "I'll just have each of these fellows play over a selection or two in front of the telephone, and you can make your choice right now."

Accordingly the violinists entered into a competitive examination with the examiner seventy-nine miles away, but listening to every note as it swelled up from the transmitter. When he had heard all four of the men play the bandmaster had one of the violinists play again, and then calling the clerk of the musical agency, said: "That man that I asked to play a second time is the one I want. He fingers well and brings his notes out clearly. Engage him and send him down on the next train, which leaves in less than half an hour."

ANOTHER DETECTIVE STORY.

On another occasion the New York Detective bureau had one of its matrons in charge of women prisoners call up an embezzler who was a guest of a down-town hotel. The matron in her most dulcet tones informed the embezzler that a mutual friend had told her of his presence in the city and that she was anxious to meet him. When the man began to talk, asking the woman how she came to hear about him and for her to name a meeting place the police deftly handed the receiver over to the President of the bank that the embezzler had looted and who had come on to New York in search of the fugitive. The President recognized the voice over the telephone as being that of his man, and an officer was immediately dispatched to make the arrest.

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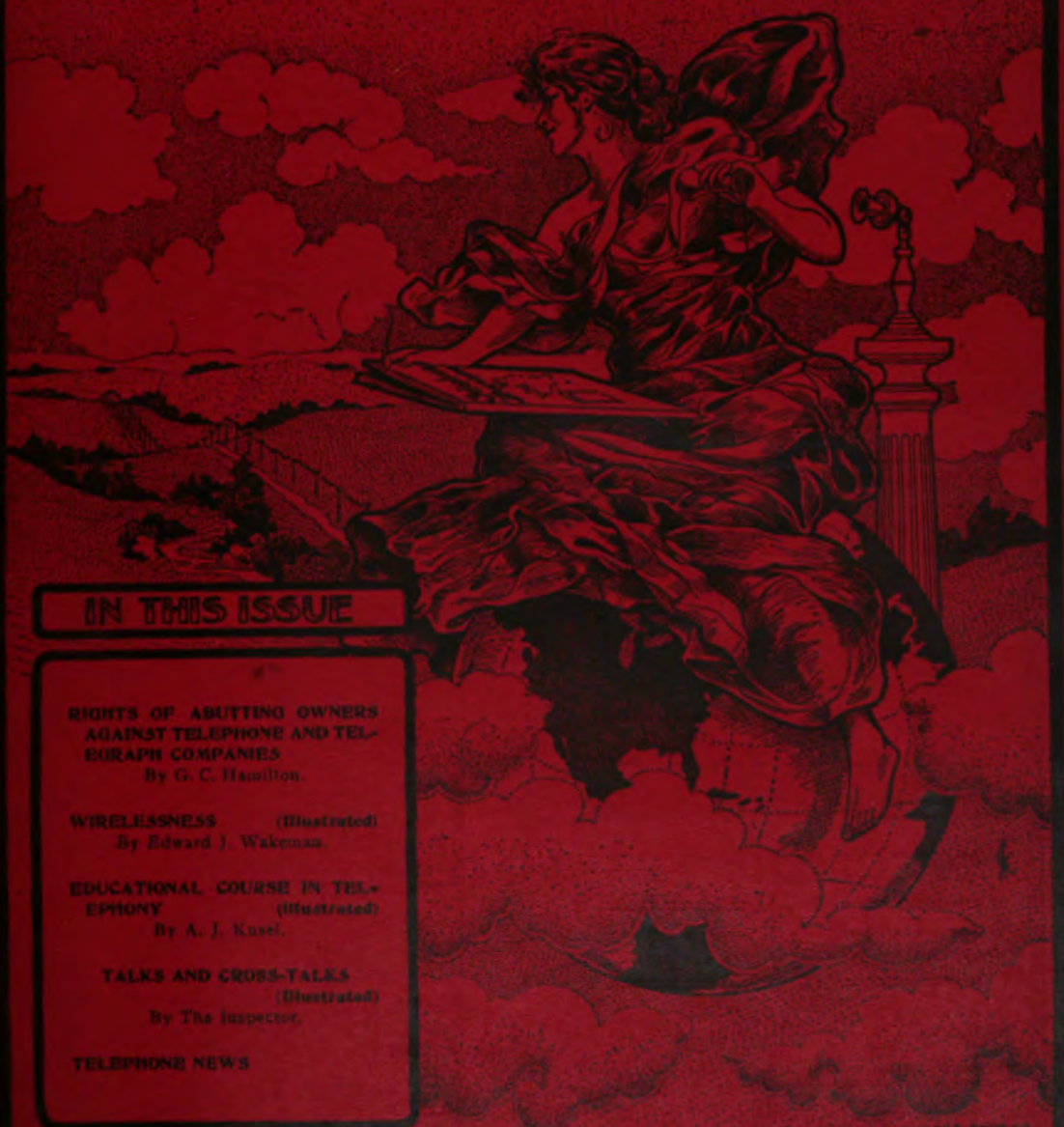

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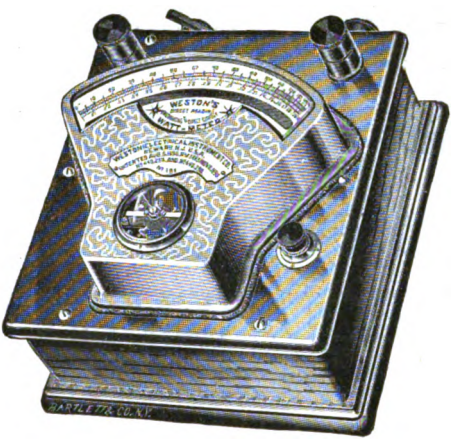

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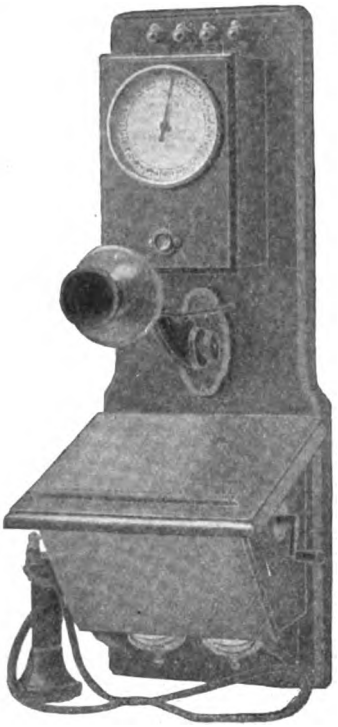

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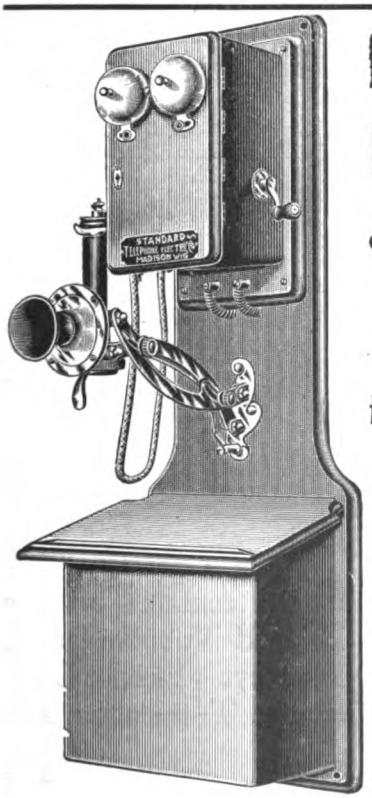

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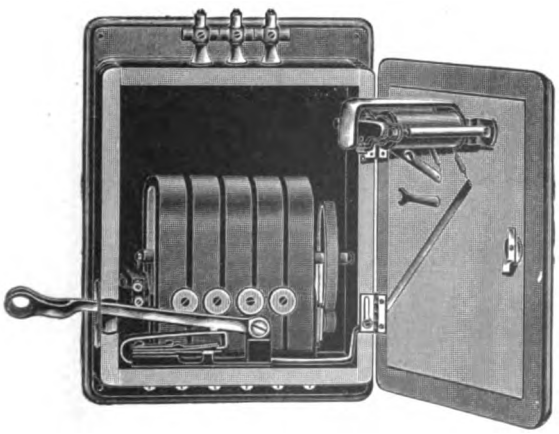

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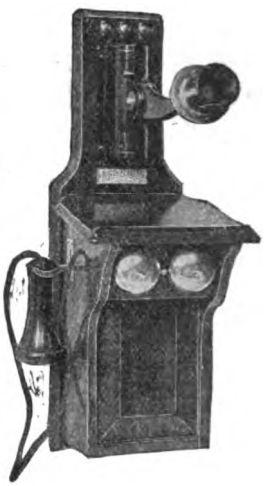

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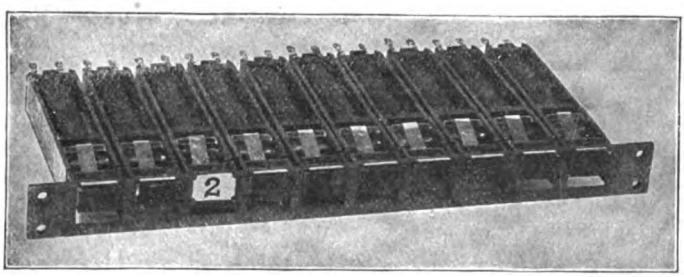

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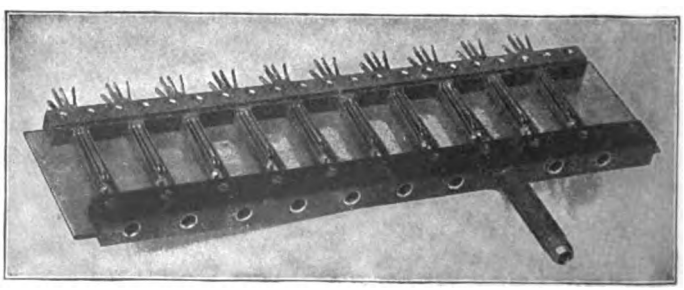

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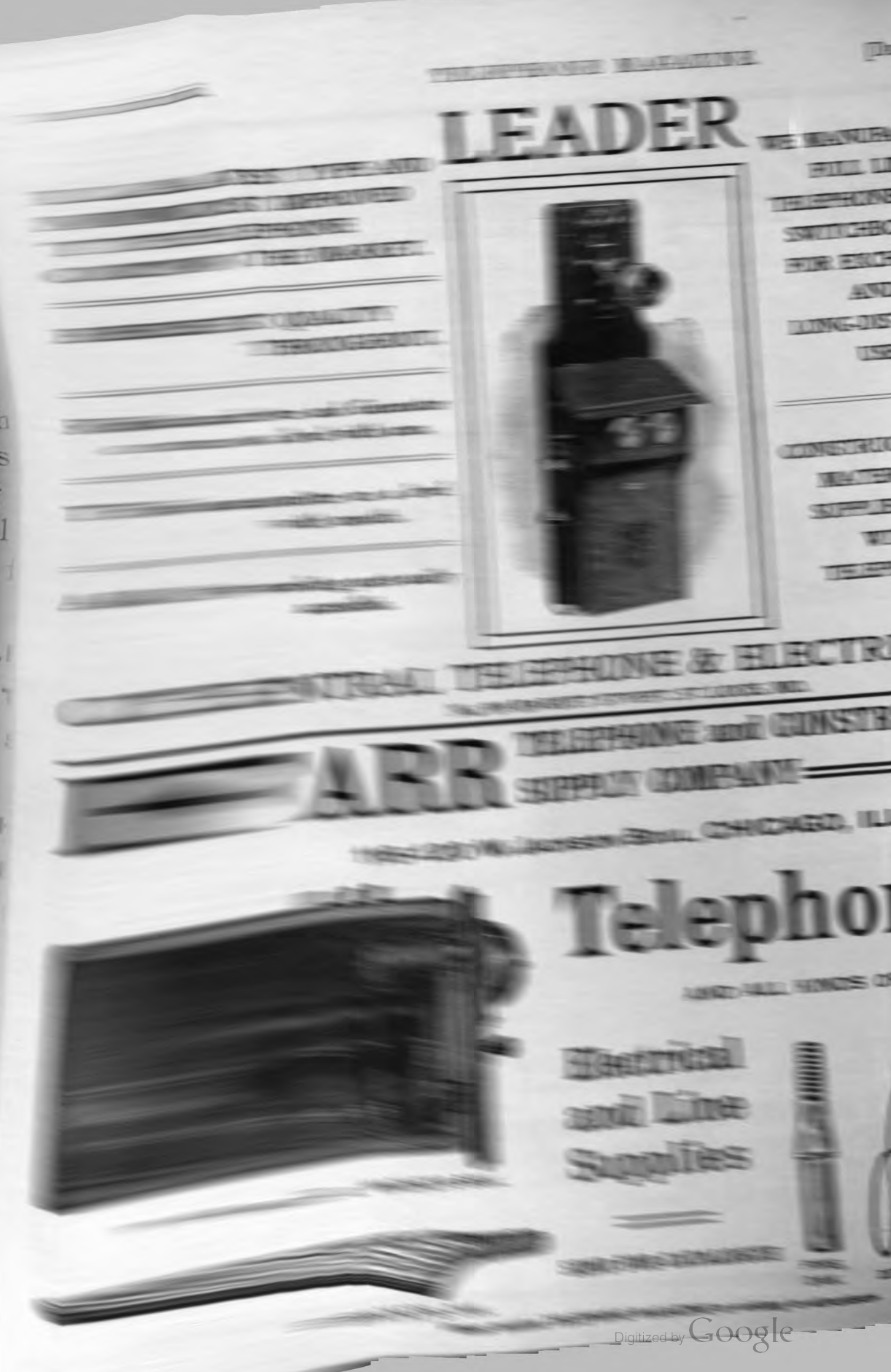
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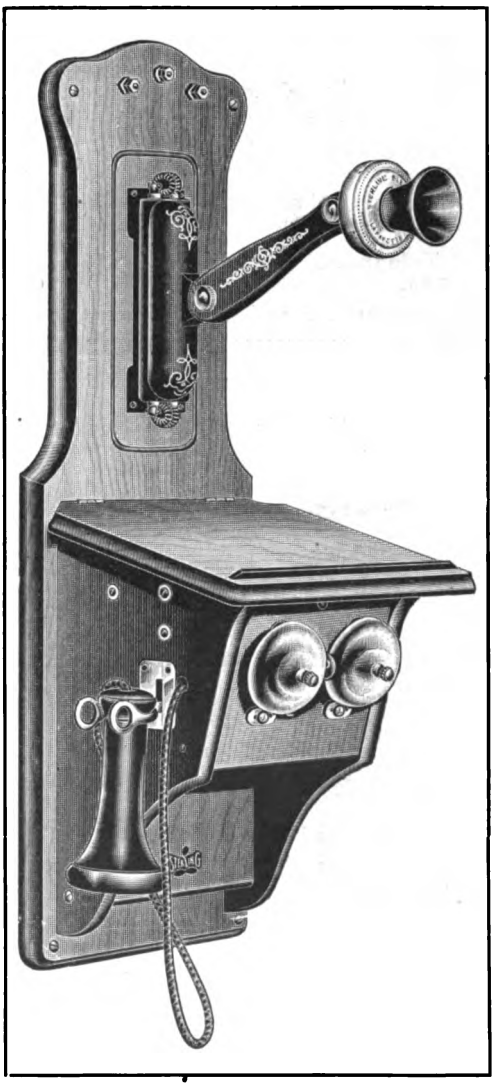

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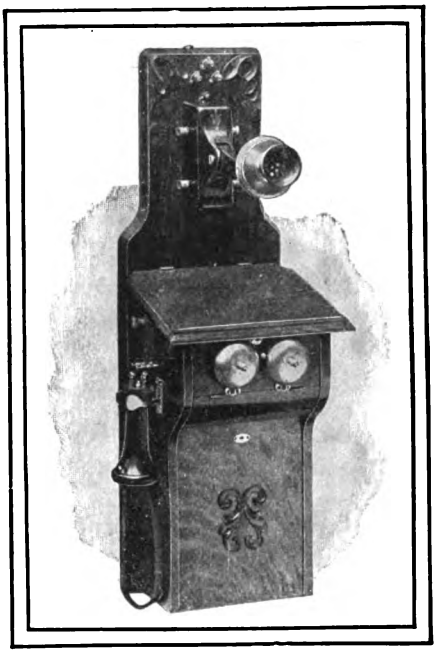

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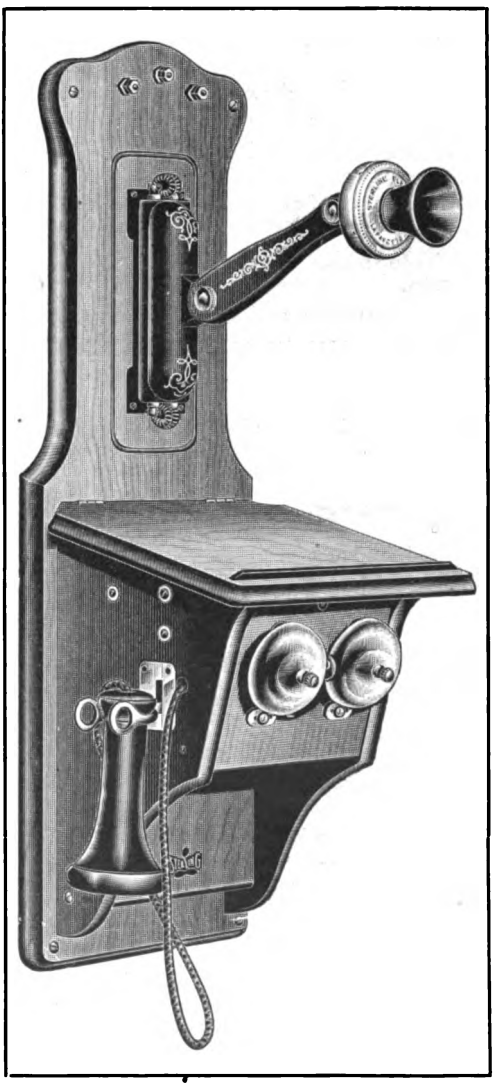

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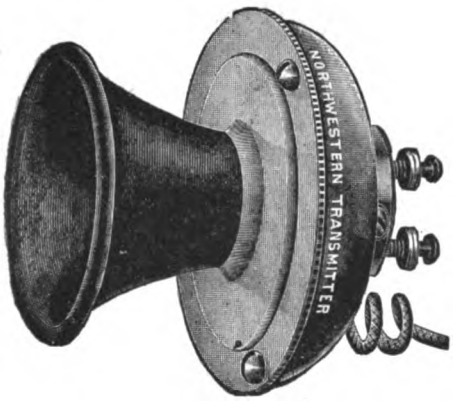

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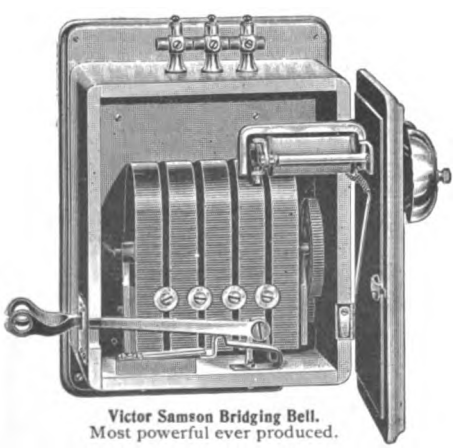

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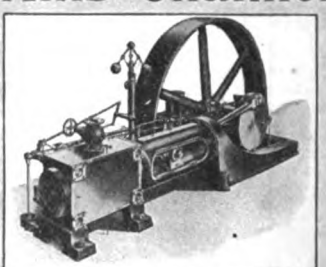

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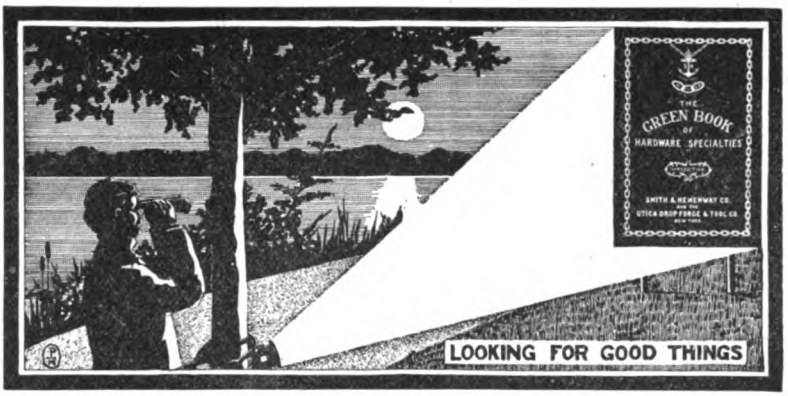

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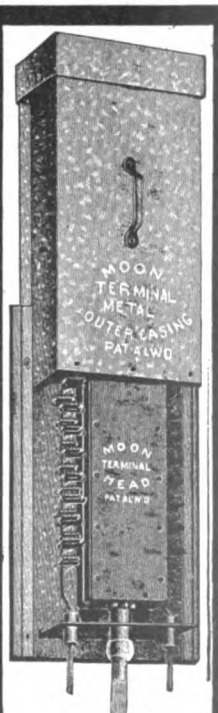

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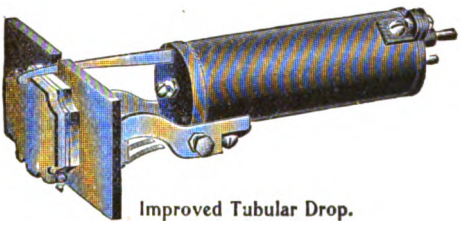

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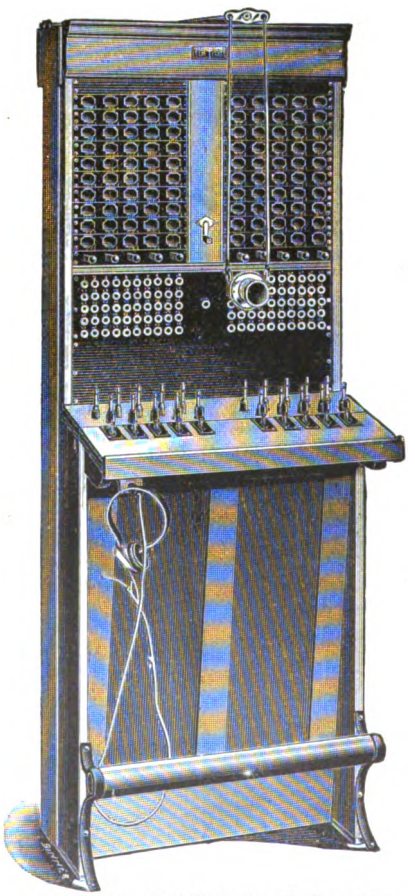

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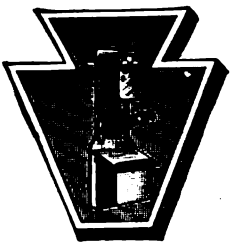

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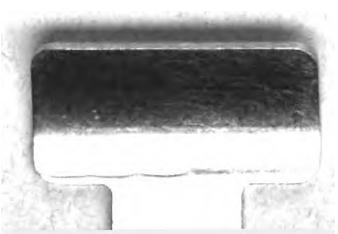

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